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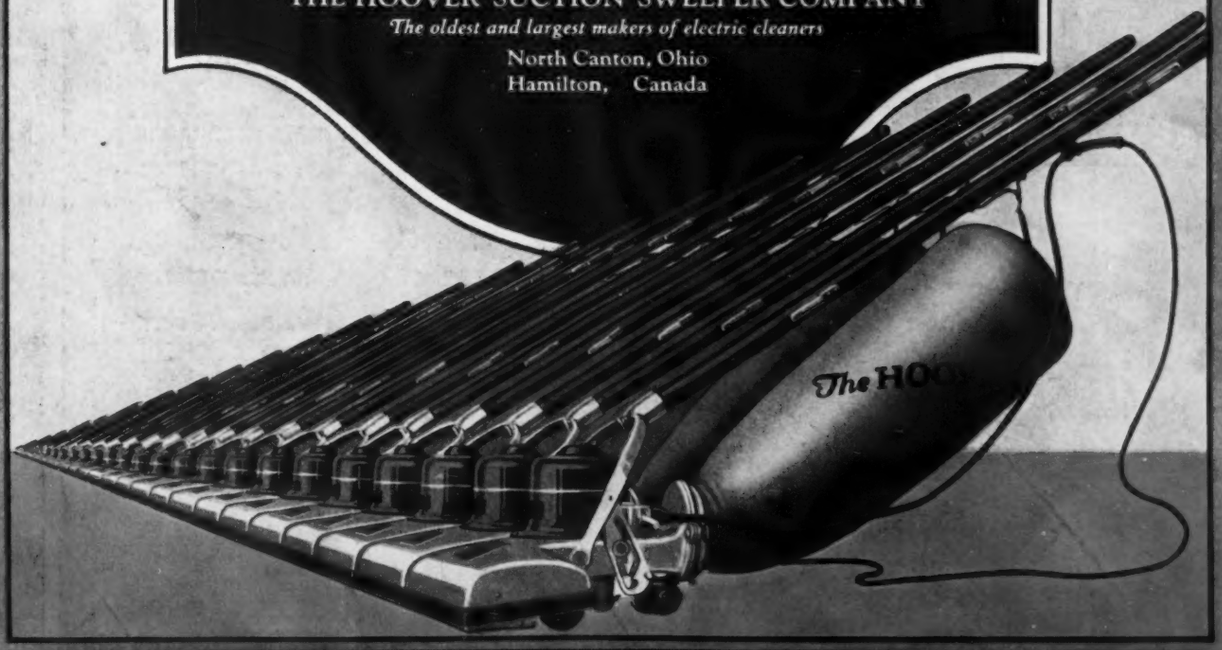

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At Peace with the Public

THE chairman of a public service commission has expressed the belief that the relations of the public and utilities are exhibiting marked improvement, due in a large measure to the broader viewpoint that the men responsible for utility management are taking. That men who stand as umpires between utilities and the public are able to say that a marked change for the better is observable is encouraging because it indicates that utility management in general is studying its problems from the standpoint of the value of its service to the public rather than the value of the public to the utility. A thorough appreciation and application of this viewpoint will do more to solve utility difficulties than any other one factor, because it makes for the giving of full value for what is received. This, after all, is what the average human being wants.

Coal Clause Justification

A SOMEWHAT unusual and what appears to be a narrow point of view is contained in a decision of the Public Utilities Commission of the District of Columbia handed down this week in the Potomac Electric Power Company rate increase case. The company was granted a rate increase, but it was denied its request to include in its tariff schedule a coal clause on the grounds that there would be less incentive to secure coal at the most advantageous price when it is known that the cost is automatically passed on to the consumer. Aside from the manifest unfairness of an almost inflexible rate under existing rapidly changing costs, does it seem reasonable that any utility would grow careless in its purchasing simply because its costs were guaranteed? From a public policy point of view, if from no other, a utility would naturally do everything in its power to prevent a rate increase. It appears as though the Public Utilities Commission in its eagerness to keep the faith with the public has overlooked a fundamental consideration in the psychology of public utility management.

Advertising a City

NOT long ago the Union Gas & Electric Company of Cincinnati engaged in an extensive advertising campaign in the large metropolitan dailies in the East calling attention to the advantages of Cincinnati as an industrial center. Not the least of these advantages is an abundant supply of electrical energy. More recently the Consolidated Gas, Electric Light & Power Company of Baltimore engaged in a similar campaign locally, dilating on the commercial and shipping advantages of Baltimore, and here, too, attention was called to the asset which Baltimore possesses in an abundant supply of steam and hydro-electric energy. This same tendency to accentuate the advantages of abundant electricity supply, pure water, etc., will be evident to the observer traveling throughout the country. Boards of trade, chambers of commerce, and other civic organizations usually publish such facts about their communities on billboards along the railroad lines for the benefit of industries seeking to establish themselves in strategic places. The practice is commendable, but what is sauce for the goose is sauce for the gander, and if electricity is an asset to communities seeking new industries, townspeople should be made to appreciate it as much as strangers. As a matter of fact their appreciation means more to the utility. Hence the advantage of advertising locally as well as nationally.

Frankness the Best Policy

SOME central station companies lucky enough to have accumulated fair stocks of coal during recent trying times (by no means over) are tempted to draw the veil of secrecy over their fuel situation through fear of curtailment of shipments should the exact quantity on hand become public. It is laudable for such companies to strive to render the best possible service to their customers by storing coal well in advance of its use, but do not some of our good friends betray needless alarm over divulging the size of their stocks? "A city set upon a hill cannot be hid," and neither can a coal field of ten to fifty thousand tons unless under-water storage be utilized to an uncommon degree. Granted that the competition for fuel is terrific, the present and prospective needs of operating companies for many months to come can be estimated with excellent accuracy. The difference between hoarding and between fuel conservation should be easily discovered, and, in the face of clear-cut demonstrations of requirements, frankness ought to win over both public and private agencies concerned with the equitable apportionment of the mining yield. Regulation is the answer to continued profiteering, whatever may be its nature, and an open-book policy would seem best in the long run for those who are dependent in the last analysis upon public opinion for fair treatment in securing their reasonable necessities.

What Not to Do

IN MATTERS of public policy managers of electric light and power properties have much to learn from their brothers in other public utility fields. They have also much to avoid. For instance, there are two large railway strikes under way at present in the East; one at Bridgeport and the other in Brooklyn. Strikes, of course, are not uncommon occurrences, but these differ radically because in Bridgeport it is the railway company which has taken upon itself to cease operations, hoping thereby to redress certain grievances

against the city, while in Brooklyn the men have gone out for higher wages. The effect on the traveling public, however, is the same in both cases; it is without street railway service and must walk or employ whatever means of transport is available, which leads us to remark that every strike on public utilities should be made a penal offence. The strike in Bridgeport, we are told, is for purposes of demonstration. Now demonstrations are excellent in themselves, although in Bridgeport winter would have been a better time to show the superiority and adequacy of electric railways over jitneys; but no utility has the right to shut down and subject the public to inconvenience just for purposes of demonstration. Imagine the railroads of the country shutting down because auto trucks and pleasure cars eat into their freight and passenger earnings. As public servants it is just as obligatory for electric light and power companies, street railway companies, gas and water companies to continue to render service as it is for the municipal authorities to afford police and fire protection. Let there be no mistake about that. Competition in the utility field succumbs to better and cheaper service, and that not for a day or a month, but year in and year out. Certainly no properly financed and managed electric railway, if it has any justification for existence at all, should have any trouble in proving the superiority of its service over that of the jitney. Service is what counts, but how can a utility expect to win public approval and support if it renders no service at all?

French Version of Electron-Tube Development

THE electron has ceased to be a name for an abstract laboratory conception. An electron is a useful device in commercial engineering. It is a very small device, hopelessly ultramicroscopic at present; but there are billions of them available, and when they are organized in a vacuum tube, in such a manner that each will carry an electric charge, and release the same at the surface of an electrode, under command of the operator, the service of the electron is a very noteworthy commodity.

So rapidly has the vacuum-tube electron device come into service during recent years that it promises to be an important factor in electrical-engineering progress. It is quite possible that vacuum-tube engineering may become a recognized specialty in design, construction and use. Aside from its well established place in communication systems, the vacuum-tube finds important applications in measurement work and may even become a part of power plant relay systems in the future.

The theory of vacuum-tube operation has already made notable advances, and cannot be ignored by those who desire to specialize in this branch of electrical application. An interesting contribution to the subject is made by Marius Latour in this number. The material has already made its appearance in French, but it is here translated and collected into a useful summary. The method of analysis adopted is that of resolving emfs. into perpendicular components.

The theory of the self-oscillation of a triode vacuum-tube is of great utility, and is very simple when only a single tube is involved. When, however, a number of tubes are used in cascade, the case becomes very complicated, and various unexpected reactions may arise. There is much room for developing the theory and technique of multiple amplifiers, in such a manner as to exclude the extraneous factors, and retain under control the fundamental elements of the system.

A Basic Power Investigation

SELDOM does the publication of an engineering report nearly two years after its field work is done yield conclusions of so much value as are embodied in Major Carroll H. Shaw's résumé of the War Industries Board report on the New England power situation, printed in this issue. Prepared under his direction to insure continued adequate electrical service in that crowded area of the nation's workshop, this investigation commanded from the outset the respect and hearty co-operation of utilities and industrial plants. Released for publication at a time when economic conditions have attained an abnormality little expected at the close of hostilities, the report naturally contains prophetic figures which would require extended verification if applied today in detail to the changing trend of electrical supply conditions, and yet its inferences and deductions are so sane and so thoroughly determined that the investigation will long stand as a basic inquiry into the power resources of the territory that is covered.

Interconnection and centralization of power production were in process in New England in the pre-war period. The work of Major Shaw and of his predecessors, however, focused attention upon the existing and potential resources of the district and undoubtedly quickened the movement toward more efficient energy supply. Electric plants of all kinds took account of stock, learned anew the possibilities of pooled resources and were brought closer to a solution of the ever-growing problem of conserving fuel, expanding plants in the face of rising overhead and operating costs and analyzing facilities and their use on behalf of more efficient service.

The completeness of the data assembled in the report leaves little to be desired in summarizing the industrial and public utility power resources of this area to the close of the war. The information presented came straight from headquarters; it represents full and cordial co-operation between the representatives of industry and of the government, and is of permanent value. In some cases the conduct of the survey by central-station men working in harmony with the power section of the War Industries Board disclosed new prospective business, and in many ways the turning of the light of inquiry inward revealed conditions of unsuspected interest and significance to utility and industrial plant executives.

Power development since the armistice has proceeded in New England along many of the lines forecasted in the report. The magnitude of individual plant expansion has varied a great deal because of conditions unexpected by many companies eighteen months ago. The anticipated hydro-electric development has been greatly curtailed by the high cost of capital, although several large and important plants are under construction or recently have been completed. Steam plant expansion has been notably large. Interconnection has progressed rapidly toward larger achievements from one end of New England to the other, and the public mind has ripened toward a comprehension of the benefits of

centralized generation, concentrated power production and trunk line transmission hitherto conspicuous by its absence. Electric railways and industrial plants are turning in increasing numbers to central-station service. The latter maintains a lead of at least 30 to 50 per cent in fuel economy, but much more remains to be accomplished in improving the efficiency of both central station and industrial power supply. Later studies of plant operation indicate that at present far more fuel is being wasted in both types of plants than was apparent when Major Shaw and his assistants combed the field. So clear a statement of the resources, tendencies of development and opportunities for increasing the efficiency of power production and distribution as this report establishes may well be characterized as fundamental.

Improved Permanent Magnet Theory

A PAPER on this subject, by S. Evershed, was recently read before the Institution of Electrical Engineers in London and abstracted in the *Electrician*. The paper is a valuable contribution to the literature of the subject. Since Hopkinson's work we have had a good working theory of the electromagnet, and we have been able to design electromagnets fairly well, for the purpose of dynamo-electric machinery. We have had, however, no corresponding good working theory of permanent magnets and their design has been largely empirical. The Evershed paper, however, offers an improved working theory and gives design criteria, as well as rules for design procedure.

The keynote of the paper is available magnetic volume energy, or the magnetic ergs per cubic centimeter of permanent magnet available in the useful magnetic field. The purpose of the permanent magnet is to supply a reliable flux density within a certain region between the poles. This means a corresponding definite number of magnetic ergs in this polar region. The smaller the number of cubic centimeters of permanent magnet used to supply this external energy the more effective is the magnet. Good design calls for the greatest external available energy from a given volume and weight of permanent magnet.

A number of interesting byproducts accompany the paper, such as an estimate of the velocity of the electrons in their atomic orbits, which, according to the Amperian hypothesis, give rise to the molecular property of permanent magnetism. The estimated velocity is about 600 km. per second, or enough to encircle our globe in a little more than a minute.

The theory of permanent magnetism is more abstruse than that of electromagnetism, because of the reaction of the flux in the magnetomotive force of the circuit. A bar magnet is to be considered as a magnetic battery, formed by a series association of a vast number of atomic magnetomotive forces. The bar magnet has a certain internal resistance and also a certain external resistance in the air. Neither of these quantities can be easily computed in the ordinary case. The drop of potential across the air sets up a counter mmf. which tends to demagnetize the bar. It actually does demagnetize it to a certain extent. The bar settles down to a fairly stable condition, in which its retentive force produces a flux that cannot shake out any more magnetism, through the action of the counter mmf. All this has to be digested mathematically and simplified in such a manner that magnetic engineers can use the theory. A very distinct advance in this direction has been given by the papers.

Power Developments in the High Sierras

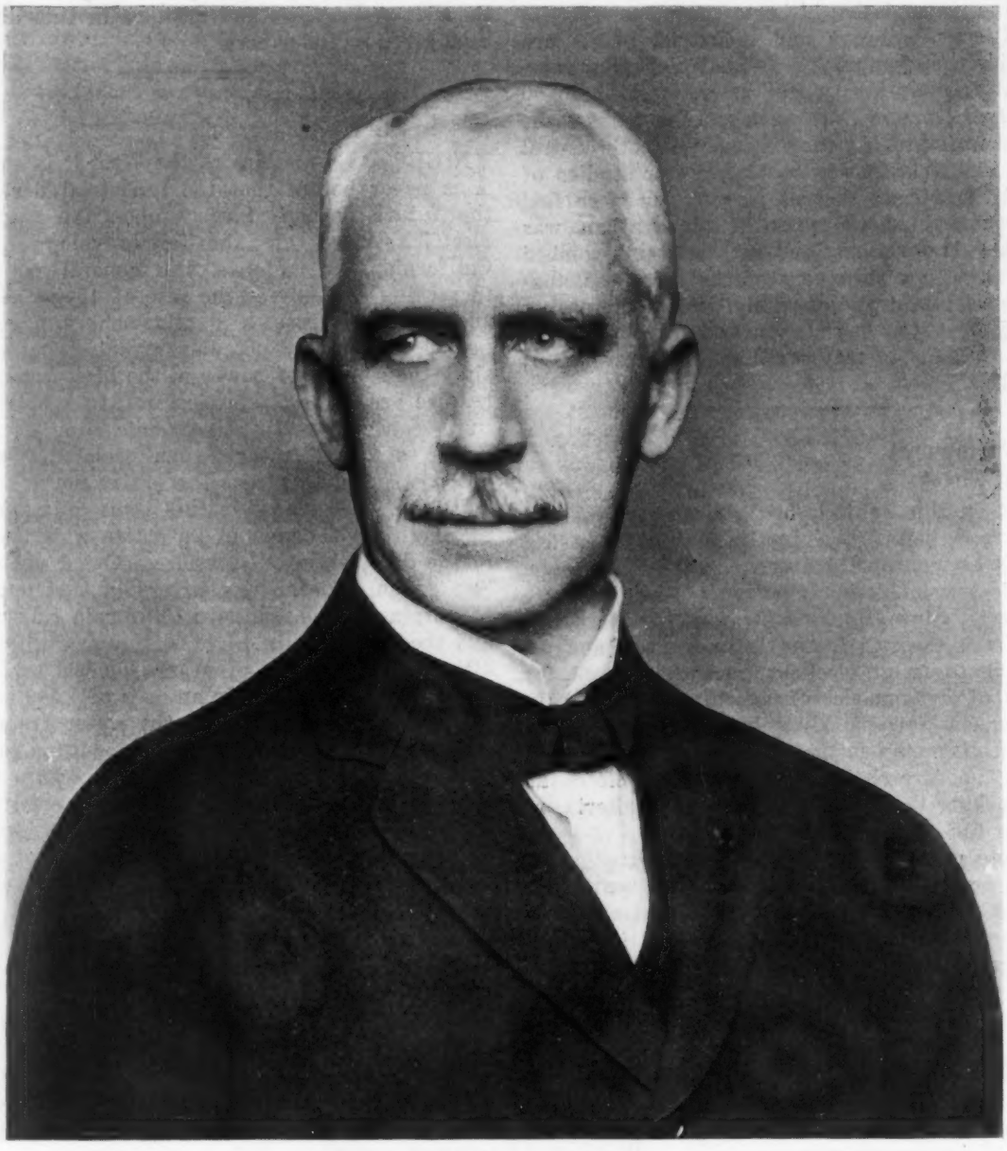
IN CERTAIN sections of the West it is now apparent as never before that the industrial development of the future depends largely upon the availability of electric service. In the fertile valleys of southern California, for instance, the general power load is increasing annually at the rate of 15 per cent. Under such circumstances a development program over a period of years is not only essential but compulsory, since the sources of power in the high Sierras not only require years for completion but, to keep the cost per unit capacity within economic limits, groups of power stations, rather than isolated plants, must be constructed to utilize the entire power available on a stream. Elsewhere in this issue an example of the thorough development of an entire watershed is given in the description of several co-related projects on the San Joaquin and Kings Rivers in the Sierra Nevada Mountains by the Southern California Edison Company and the San Joaquin Light & Power Corporation. An ultimate development of nearly 900,000 kw. is outlined which will be available in an area of 1,500 square miles and will use the energy of the water from elevations of 7,000 ft. down to 1,000 ft. In addition to the power realized, a great benefit to the state will come through the regulation of the stream flow permitting water to be released during the late summer when it will be of inestimable value in the irrigation of the productive San Joaquin Valley, into which the rivers referred to flow.

Financing of Public Utilities

THE outstanding problems in public utility work at the present time have to do with regulation and finance. In a measure both are really one, since for their solution they require public confidence, above everything else. Without that neither the financing of utilities nor their proper regulation can make much headway. The rank and file in the industry know fairly well what regulation means, but have but a faint comprehension of the financial burdens under which public utilities labor. For that reason the contribution by Dr. Gephart on Financing Electric Public Utilities is both opportune and instructive.

The public has absolutely no appreciation of the heavy investment in public utilities compared with the infrequency of capital turnover and the necessity of adequate rates to safeguard that instrument. For instance, the total income of the largest hydro-electric plants in the country is a little more than one-sixteenth of the investment.

Hence, with the heavy fixed charges which must be incurred any decrease in income, however slight, jeopardizes the entire property. The ratio of income to investment in steam-driven systems is much more favorable, but ridiculous compared with that of other industries, some of which do a tremendous business on a "shoestring." Dr. Gephart's article speaks for itself and his observations ought to go far toward clarifying the thought of every man in the industry on the important question of finance.



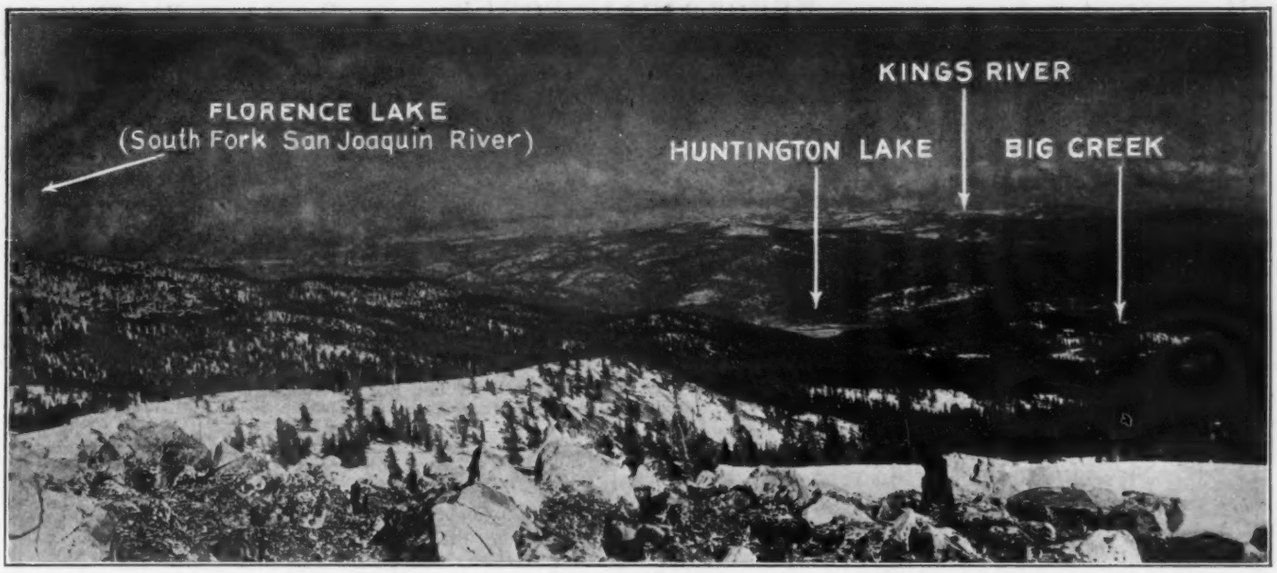
George Herbert Harries

A distinguished soldier and public utility executive, whose services to his country and to the public have gained well-merited recognition

YEARS of successful leadership as a public utility executive and a military career marked with such signal honors as have come to Brig.-Gen. George H. Harries is a combination of public service that is rare. General Harries' military days date back to the frontier wars with the Indians, when he served as scout under Generals Miles and Crook. In the Spanish-American War, as Colonel of infantry volunteers, he participated in the siege of Santiago. In the World War, as Brigadier-General in the National Army, he was in the thick of things at Verdun, then at Brest, and finally at Berlin as American commissioner on the repatriation of allied prisoners of war, the first American to reach the goal coveted by the soldiers of all the allied nations. Nine months of distinguished service in Berlin amid revolutionary turmoil brought to him decorations from several countries, including that of Commandeur of the French Legion of Honor and the Distinguished Service Medal of the U. S. A.

General Harries' career in civil life has been equally as active. As a reporter on the Washington (D. C.) *Star* in his early twenties he became familiar with electric railway affairs, and at thirty-five he was elected president of the Metropolitan Railroad of Washington. Later, as a member of the board of directors and vice-president of the Washington Railway & Electric Company, he participated in the consolidation of electric light, power and railway properties of the capital city. In 1911 he became identified with H. M. Byllesby & Company as vice-president and for some years was stationed at Louisville, Ky., in charge of the affairs of the Louisville Gas & Electric Company and the Omaha (Neb.) Electric Light & Power Company as president of both companies, and assisted also in the general administration of several other of the Byllesby properties.

In the public utility field General Harries brought, besides an unusual organizing ability, a comprehensive knowledge of central-station operation and a close familiarity with the finesse of financing. These characteristics of leadership have elected him president of the American Electric Railway Association, president of the Association of Edison Electric Illuminating Companies and caused appointments to the executive and public policy committees of the N. E. L. A., the honorary degree of Doctor of Laws from the University of Kentucky, and just recently his election as president of the Illuminating Engineering Society. General Harries was born in Haverfordwest, South Wales, in 1860, the son of an officer in the British Army.



LOOKING SOUTH FROM ELEVATION OF 10,000 FT. ACROSS HUNTINGTON LAKE AND BIG CREEK TOWARD THE KINGS RIVER COUNTRY

High Sierras Hydro-Electric Developments

Generating Stations with a Total of 850,000 Kw. Which Will Produce 4,000,000,000 Kw.-Hr. per Annum Are Included in the 1920 to 1930 Construction Programs of the Southern California Edison Company and the San Joaquin Light & Power Corporation of California

PLANS that have been completed for the development of power sites in the high Sierras in Central California embrace an area totaling approximately 1,500 sq. miles (3,750 sq.km.) and call for a generating station rating of 850,000 kw. The ultimate total annual output for all the contemplated plants will be in excess of 4,000,000,000 kw.-hr., of which 2,400,000,000 kw.-hr. will be generated by water stored in reservoirs at high elevations. This seasonal and annual storage of water will so control the stream flow to the valley that the often-destructive floods during the snow-melting period in the spring will be prevented and the water will be more uniformly released during the summer and fall, when it is so greatly needed for power and for irrigating the fertile but semi-arid sections of the San Joaquin Valley, well over a mile lower in elevation.

The mountainous area referred to is drained by the San Joaquin and Kings Rivers, shown on the large map on page 514. The San Joaquin River and its many tributaries drain the northern portion of the area and the Kings River the southern portion. Two companies, the Southern California Edison Company and the San Joaquin Light & Power Corporation, are making the developments. The latter is just starting the work of developing the Kings River, which will ultimately produce 200,000 kw. by means of seven power houses, ranging in elevation from 890 ft. (271 m.) to 6,300 ft. (1,920 m.) above sea level.

That company has, among its thirteen hydro-electric

SAN JOAQUIN AND KINGS RIVERS DEVELOPMENTS

RESERVOIRS

Southern California Edison Company	Capacity Acre-Ft.	Drainage Area Sq. Miles	Elevation Ft.
Vermillion Valley	90,000	91.2	7,500
Blaney Meadows	15,000	144.0	7,500
Florence Lake	40,000	77.5	7,300
Huntington Lake *	88,000	71.0	6,950
Shaver Lake **	146,000	55.5	5,370
Granite Creek Reservoir	22,000	66.6	6,980
Jackass Creek Reservoir	27,000	33.5	7,000
Chiquito Creek Reservoir	18,000	60.0	5,000
Mammoth Pool Reservoir	28,000	665.0	3,000
Total	474,000	1104.2	
San Joaquin Light & Power Corporation			
Lake Wishon	128,000	178	6,550
Meyer Lake	21,000	19	6,850
Peart Lake	53,200	65	5,650
Crane Valley ***	17,000	40	4,500
Total	219,200	302	

* Huntington Lake now completed to 88,000 acre-ft.
** Partially completed.
*** Completed to 14,000 acre-ft.

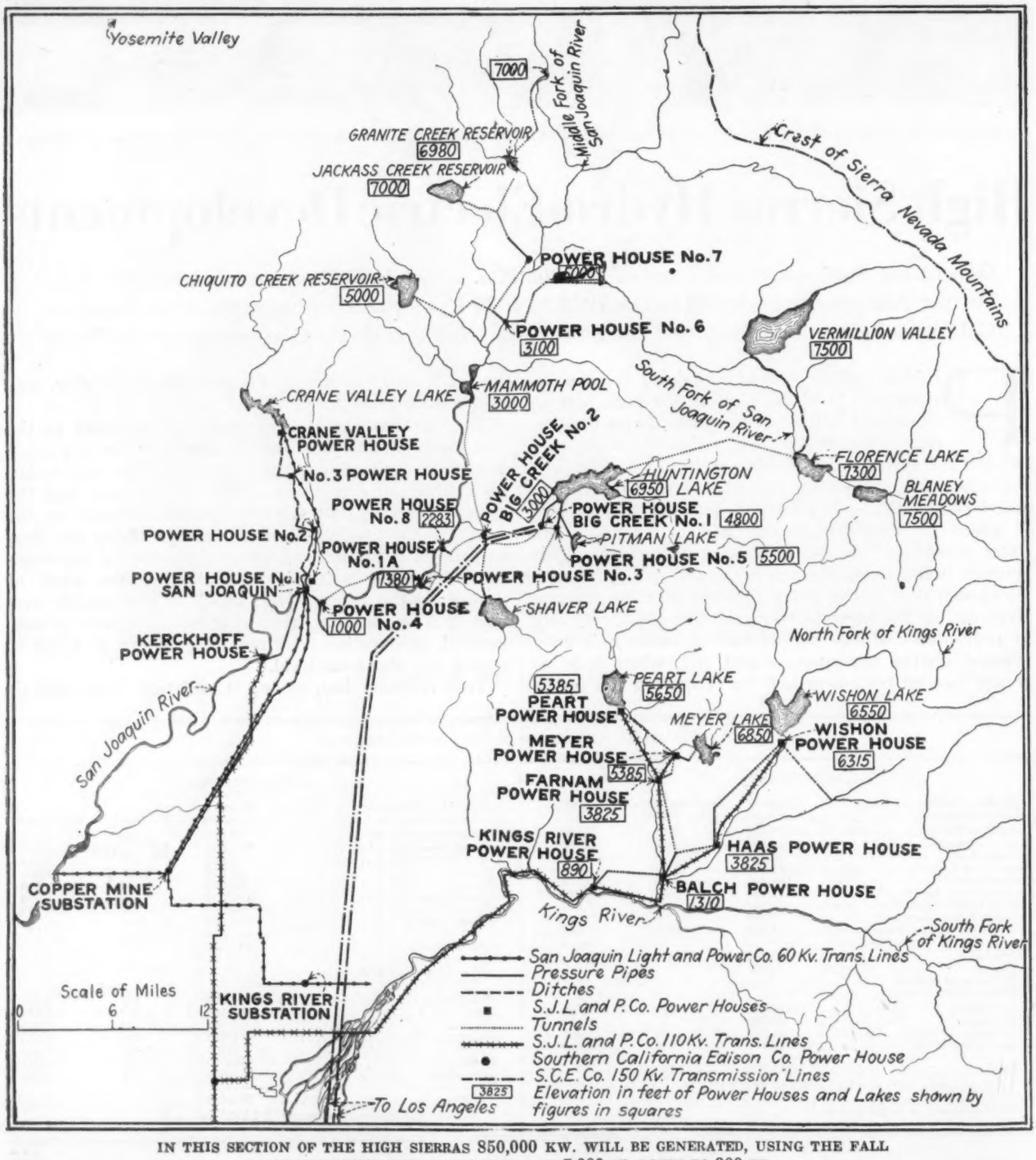
POWER HOUSES

Southern California Edison Company	Kilowatt Capacity	Ft. Head	Elevation
Power House No. 1*	64,000	2,130	4,800
Power House No. 2*	143,000	1,860—2,400	3,000
Power House No. 3	90,000	825	1,380
Power House No. 4	40,000	380	1,000
Power House No. 5	80,000	1,480	5,500
Power House No. 6	110,000	1,650	3,100
Power House No. 7	30,000	1,900	5,000
Power House No. 8	90,000	717	2,283
Total	647,000		
San Joaquin Light & Power Company			
Wishon	5,000	235	6,315
Haas	61,500	2,475	3,825
Balch	92,500	2,500	1,310
Peart	1,950	265	5,385
Meyer	5,000	1,465	5,385
Farnham	19,500	1,545	3,825
Kings River	17,000	410	890
Total	202,450		

*Now in operation with capacity of 32,000 kw. each.

generating plants in operation at the present time, six power stations of a total rating of 48,000 kw. on one of the lower forks of the San Joaquin River. One of these power houses, No. 1, is at the junction of this fork with the main stream of the San Joaquin River and another, the Kerckhoff, which was placed in operation Aug. 15, 1920, on the main stream with its intake below power house No. 1. The Kerckhoff station therefore obtains the benefit of the regulation of the stream flow controlled by the reservoir systems in operation and planned on both the North Fork and main stream.

Above the junction of the fork noted, with the main stream of the San Joaquin River, the developments are being made by the Southern California Edison Company. In operation at the present time by that company are two power houses, known as Big Creek No. 1 and Big Creek No. 2, on Big Creek, which is a tributary to the main river and drains an area of 95 sq. miles (246 sq.km.). A reservoir known as Huntington Lake, with a capacity of 88,000 acre-ft. (108,000,000 cu.m.), stores water above Big Creek No. 1 power house at an elevation of 7,000 ft. (2,100 m.). The Kings River development and the San Joaquin River development are separate from a hydraulic standpoint, but as the transmission systems fed by the power houses on the two rivers will be closely interconnected the programs for the development of the power available on the two streams are closely inter-related.



IN THIS SECTION OF THE HIGH SIERRAS 850,000 KW. WILL BE GENERATED, USING THE FALL OF THE RIVERS FROM ELEVATIONS OF 7,000 FT. DOWN TO 900 FT.

The catchments planned by the Southern California Edison Company for construction on the San Joaquin River system, beginning with those at the highest elevations, are as follows. The Blaney Meadows Reservoir, at an elevation of 7,500 ft. (2,280 m.), with a storage capacity of 15,000 acre-ft. (18,500,000 cu.m.) and an ultimate yield through all the power houses below of 66,000,000 kw.-hr.; the Vermillion Valley reservoir, at an elevation of 7,500 ft. (2,280 m.), with a capacity of 90,000 acre-ft. (110,000,000 cu.m.) and a yield of 396,000,000 kw.-hr. Other reservoirs on this system are Florence and Huntington lakes and Shaver Lake, feeding the various power houses, as outlined in the June 7, 1920, issue of the ELECTRICAL WORLD, page 1334, and noted in the accompanying table.

The output of the two plants now in operation on Big Creek is transmitted 240 miles (386.2 km.) to Los Angeles over a double-circuit, 150,000-volt, steel-tower transmission line. A substation under construction north of Bakersfield will step-up from 75,000 to 150,000 volts for transmission to Los Angeles the energy from the nearly completed 30,000-kw. Kern River No. 3 plant of the Southern California Edison Company, now being built on Kern River. This plant was described on page 116 of the July 19, 1919, issue of the ELECTRICAL WORLD. This substation will also supply energy to the system of the Mt. Whitney Power & Electric Company, a subsidiary of the Southern California Edison Company, and will also serve as a point of interconnection with the San Joaquin Light & Power Corporation, through a 15,000-kw., 50-cycle and 60-cycle frequency changer.

Since the economical limit of capacity of the two 150,000-volt Big Creek lines is approximately 125,000 kw., there will soon be required either additional circuits or higher voltage to transmit the rapidly-to-be-increased output from the San Joaquin River power system. Design and economy studies of 220,000-volt transmission are now under way by the Southern California Edison Company, which include the reconstruction and reinsulating of the present 150,000-volt lines for 220,000-volt operation and will double their capacity. Line insulation is being given particular consideration. Various arrangements of shields for better distribution of the duties of the individual insulator units in suspension strings have been tested and the results indicate that a satisfactory solution will be found.

KINGS RIVER NORTH FORK DEVELOPMENT

The development by the San Joaquin Light & Power Corporation on the North Fork of the Kings River includes power houses as follows: Wishon, 5,000 kw., head 235 ft. (71 m.); Haas, 61,500 kw., head 2,475 ft. (755 m.); Balch, 92,500 kw., head 2,500 ft. (762 m.); Peart, 1,913 kw., head 265 ft. (81 m.); Meyer, 500 kw., head 1,465 ft. (445 m.); Farnham, 19,500 kw., head 1,545 ft. (470 m.), and Kings River, 17,000 kw., head 410 ft. (124 m.). Especially noteworthy are the high heads of the Haas and Balch plants. Other details of this development appeared in the ELECTRICAL WORLD March 20, 1920, page 669.

The reservoirs on this river are not quite as extensive as those planned on the San Joaquin River, there being but three reservoirs planned, known as Lake Wishon, at an elevation of 6,550 ft. (1996 m.), having a capacity of 128,000 acre-ft. (177,500,000 cu.m.), drainage area 178 sq. miles (461 sq.km.); Meyer Lake, elevation 6.850 ft. (2,087 m.), capacity 21,000 acre-ft. (25,870,000 cu.m.), drainage area 19 sq. miles (49 sq.km.), and Peart Lake, elevation 5,650 ft. (1,722 m.), capacity 53,200 acre-ft. (65,500,000 cu.m.), drainage area 65 sq. miles (168 sq.km.). The plants on the Kings River will be tied in with the rest of the system of the San Joaquin Light & Power Corporation by 110,000-volt transmission lines.

The irrigation load in the San Joaquin Valley has grown at a very rapid rate. The rate of increase in the next few years will far exceed that in the past. It is therefore anticipated that the peak load of 62,000 kw. for 1920 will have increased in 1928 to a peak of 217,000 kw. The output in 1920 of about 363,540,000 kw.-hr. is estimated for 1928 at 1,340,280,000 kw.-hr. Thus, in order to be prepared to supply the load without retarding the necessary development of the immense fertile areas in the San Joaquin Valley, the development of the Kings River must proceed at a rapid pace. With the increased cost of fuel oil, plans for the further extension of the steam plants of the San Joaquin Light & Power Corporation will only be carried out by the construction of such steam plants which will use the natural gas now produced in the oil fields surrounding Bakersfield.

PRINCIPAL HIGH-VOLTAGE TRANSMISSION LINES OF SOUTHERN CALIFORNIA
Shaded portion is shown on larger scale in another illustration

The projects planned on the Kings River are to be constructed as follows: 31,000 kw. to be in operation in 1924, 15,500 kw. additional in operation in 1925, 15,500 kw. additional in operation in 1926 and 31,000 kw. additional to be placed in operation in each year 1927 and 1928, reaching a capacity at that time of 124,000 kw. The average cost per kilowatt up to a capacity of 124,000 kw. on the north fork of this river is estimated to approximate $197 per kilowatt, which will, however, be greatly reduced upon the extension of the project to the ultimate output of 200,000 kw.

THE *general public, whether it is represented by governmental heads, by Congress or otherwise, should co-operate with and assist private enterprise. Every department of government has responsibilities and opportunities of magnitude at this particular period in our history, remembering that general prosperity is the first essential. They can by precept and example contribute in rehabilitating and re-establishing the affairs of this country. For constructive statesmanship which will add to stability and progress in the moral, economic, social and political life of the nation they will be entitled to the commendation of all mankind; while a destructive policy will create distress.*—E. H. GARY.

Financing Electric Public Utilities—II

Tremendous General Demand for Capital Reflected by Rise in Bond Yields — This Reacts Against Regulated Business Because Public Utilities Cannot Quickly Change Prices to Follow Upward Tendency

By DR. W. F. GEPHART
Vice-President of the First National Bank in St. Louis

CREDIT of public utility corporations, on the whole, is at the present time more or less in disrepute as far as the general investor is concerned. This was shown in the first installment of this article, published last week, in which the yields from five average public utility bonds were compared with the yields from five average railroad bonds and five average industrials. The yields from the utility bonds were more than 2 per cent higher than either of the others.

Believing that deductions as to the average yield afforded by public utility investments as indicated on the basis of only five companies were not likely to give a fair average, a compilation was made covering seventeen highest-grade American public utility issues. Only issues rated by Moody in his "Analysis of Public Utilities" as A, AA or AAA were used.

A compilation was made showing the yield to the investor, should any of these securities have been bought at their market price during the period from April, 1919, to May 1, 1920 (Table III). On the basis of this compilation the following results were obtained: The average yield on the seventeen highest-grade public utility securities between April, 1919, and December, 1919, was found to be 6.11 per cent. The average yield from January, 1920, to May 1, 1920, was found to be 6.75 per cent.

A similar compilation was made for three of the highest-grade bond issues of the Atchison, Topeka & Santa Fé Railroad and two of the highest-grade issues of the Union Pacific. The average yield on these highest-grade railroad bonds from April, 1919, through December, 1919, was found to be 5.52 per cent. The average yield from January, 1920, to May 1, 1920, was found to be 5.75 per cent, thus showing that even the highest grade first mortgage public utility securities have recently been selling at a price which would yield the investor 1 per cent more income per annum than could be obtained from the same class of railroad securities.

A further tabulation covering the average yield on nine second-class public utility securities—that is, bonds rated by Moody as B, BA, BAA—during this same period showed that they sold at a price which would have yielded the investor, had they been bought between April, 1919, and December, 1919, 6.58 per cent. Had they been purchased at the average market price between January, 1920, and May, 1920, they would have yielded 7.20 per cent, the yield on this class of securities being almost a full point above that afforded by the highest-grade public utility security (Table IV).

Handicap of New Securities

Since the seasoned bonds of our largest public utility corporations rated by reliable investment houses as bonds having the highest grade of security can be bought on a yield basis of 6.75 per cent and those of the second class on a yield basis of 7.20 per cent, it would scarcely be expected that new securities of public utility companies could be sold on even so favorable a yield basis as that afforded by a seasoned second-grade bond.

Experience shows that new securities of the highest grade cannot be sold for the same price that a similarly secured bond can command that has been seasoned.

TABLE II—COST OF MONEY TO PUBLIC UTILITY CORPORATIONS EXCLUDING MARKETING PROFIT TO UNDERWRITERS

Date	Yield, Per Cent
Jan. 1, 1919, to July 1, 1919	6.86
July 1, 1919, to Dec. 1, 1919	6.90
January, 1920	7.10
February, 1920	7.11
March, 1920	7.59
April, 1920	7.62
May, 1920	7.83

Thus a company endeavoring to raise money through the issuance of new securities is handicapped at the very start by the fact that the securities it is offering are new and unseasoned. In addition to this the new securities of a going concern seldom rank as high in regard to the security behind them as do the seasoned issues secured by a first mortgage on the property.

New issues usually compete with the yield afforded by second-grade or junior issues, and even in competition with such issues new securities are at a disadvantage. The extent of the disadvantage in this regard is convincingly shown by a comparison of the yield basis on which new securities of public utility corporations have been offered between Jan. 1, 1919, and May 15, 1920. A study of the yield afforded by the principal representative offerings to the public of public utility securities of $1,000,000 or over in the period above mentioned was found to be as shown in Table II.

TABLE III—AVERAGE YIELD ON SEVENTEEN CLASS "A" PUBLIC UTILITY BONDS

on a basis of a fair average sale, or best bid price, computed from quotations taken from the *Commercial and Financial Chronicle* for the period April 1, 1919, to May 1, 1920. For list of bonds used, see Table IV.

Date	Yield, Per Cent	Date	Yield, Per Cent
April, 1919	5.97	November, 1919	6.38
May, 1919	5.93	December, 1919	6.49
June, 1919	5.92	January, 1920	6.47
July, 1919	5.96	February, 1920	6.69
August, 1919	6.11	March, 1920	6.78
September, 1919	6.13	April, 1920	6.99
October, 1919	6.18		
Average yield, April, 1919, to December, 1919			6.11
Average yield, January, 1920, to April, 1920			6.75
Average yield, April, 1919, to April, 1920			6.30

Variation in the yield on five highest grade railroad bonds from April, 1919, to May 1, 1920. The following bonds were used and yield was computed on the basis of sale or best bid price as shown by quotations in *Commercial and Financial Chronicle*: Atchison general 4s, 1995; Atchison adjustment 4s, 1995; Atchison convertible 4s, 1995; Union Pacific 1st 4s, 1947; Union Pacific convertible 4s, 1927.

Date	Yield, Per Cent	Date	Yield, Per Cent
April, 1919	5.35	November, 1919	5.82
May, 1919	5.28	December, 1919	5.74
June, 1919	5.35	January, 1920	5.42
July, 1919	5.32	February, 1920	5.93
August, 1919	5.61	March, 1920	5.82
September, 1919	5.76	April, 1920	5.85
October, 1919	5.52		
Average yield, April, 1919, to December, 1919			5.52
Average yield, January, 1920, to April, 1920			5.75
Average yield, April, 1919, to April, 1920			5.59

The figures in Table II were compiled from a list of bond underwritings issued by the Standard Statistics Company in its weekly service and from the *Commercial and Financial Chronicle*. (For a complete list of the bond underwritings, see Table V.)

Since the signing of the armistice interest rates the world over have been gradually rising at an accelerating rate. The weekly statistics issued by Brookmire's Economic Service in its pamphlet entitled "Brookmire's Forecaster," dated May 17, 1920, throw some interesting sidelights on current interest rates and the changes that have taken place within the last few years. Sixty-day money, New York Stock Exchange, in May, 1913, was 3½ to 4 per cent. Two years ago it was 6 per cent. For the week ended May 15 of this year it was quoted at from 8 to 8½ per cent. Discounts, prime, four to six months, New York, were 5¾ to 5½ per cent in May, 1913; 5¾ to 6 per cent two years ago; 7 per cent May 15.

How rapid the increase has been since January of this year is shown by statistics taken from the same source. Four to six months prime discounts, New York, were 6 per cent in January and 7 per cent in May of this year. Sixty-day money, New York Stock Exchange, was 7 to 7½ per cent in January and 8 to 8½ per cent in May. This tightening of the money market is reflected in every class of security in the world. United States government bonds have been selling at a price to yield the investor in many cases in excess of 6½ per cent. This situation is not due to any question or doubt as regards the security involved but is primarily indicative of the tremendous demand for capital funds, depleted by the war.

TABLE IV—AVERAGE YIELD ON NINE CLASS "B" PUBLIC UTILITY BONDS

On a basis of a fair average sale, or best bid price, computed from quotations taken from the *Commercial and Financial Chronicle* for the period April 1, 1919, to May 1, 1920. The following are the bonds used: Alabama Power 1st 5s, 1946; Chicago Railway 1st 5s, 1927; Home Tel. & Tel. 1st 5s, 1933; Laclede Gas Light 1st 5s, 1934; Pacific Gas & Electric 5s, 1942; Peoples Gas Light Co. 5s, 1947; Texas Power & Light 5s, 1937; Utah Power & Light 5s, 1944; Montana Power 5s, 1943.

Date	Yield, Per Cent
April, 1919, to December, 1919	6.58
January, 1920, to May 1, 1920	7.20

TABLE V—COST OF MONEY TO PUBLIC UTILITY CORPORATIONS EXCLUDING MARKETING PROFIT TO UNDERWRITERS

Period—Jan. 1, 1919, to May 14, 1920

	Yield, Per Cent
(*a*) Average yield on twenty-three representative issues of $1,000,000 and over, offered to the public between January 1, 1919, and July 1, 1919	6.86
(*b*) Average yield on twenty-four representative issues of $1,000,000 and over, offered to the public between July 1, 1919, and Dec. 1, 1919	6.90
(*c*) Average yield on seven new representative issues of $1,000,000 and over, offered to the public in January, 1920	7.10
(*d*) Average yield on eight new representative issues of $1,000,000 and over, offered to the public in February, 1920	7.11
(*e*) Average yield on seven new representative issues of $1,000,000 and over, offered to the public in March, 1920	7.59
(*f*) Average yield on seven new representative issues of $1,000,000 and over, offered to the public in April, 1920	7.62
(*g*) Average yield on five new representative issues of $1,000,000 and over, offered to the public in May, 1920	7.83

How seriously this situation is handicapping new improvements of public utility corporations is well illustrated by the following quotation from the *Wall Street Journal* for April 12, 1920:

Chicago Telephone Company Withdraws $10,000,000 Note Application

President Sunny has informed the Illinois Public Utility Commission that Lee, Higginson & Company and five leading Chicago bankers jointly bid 94½ per cent for the company's proposed issue of $10,000,000 three-year 7 per cent notes, or yield basis of 8.99 per cent, which is a prohibitive price for public utility credit, and therefore the company has withdrawn its application to issue these notes for needed improvements this year. The company placed a similar amount of notes with the syndicate a few years ago slightly above a 5 per cent basis.

When the cost of money to a public utility property is specifically considered at the present time, it must be realized that the cost of money to industry in general does not necessarily determine its cost to a public utility corporation. Capital does not flow so freely in actual practice as might theoretically be supposed; it is flexible only within narrow limits. The total capital fund available for investment at any time is not in active competition for all types of investment.

FLOW OF CAPITAL

Capital is controlled by various individuals and moves only in accordance with their preferences and prejudices. These preferences and prejudices are the determining factors controlling the flow of capital into the various fields of investment. Psychological forces play a very prominent part in the cost of money to industry. Very often the actual security behind a given investment proves to be of less importance than is the popular opinion regarding the security held by a large group of investors. In other words, the attitude of the investing public toward a given type of investment often becomes the dominant factor controlling the price of money in that field.

TABLE VI—COST OF MONEY TO RAILROADS EXCLUDING MARKETING PROFIT TO UNDERWRITERS

Period—Jan. 1, 1919, to May 14, 1920

	Yield, Per Cent
(*a*) Average yield on eight representative issues of $1,000,000 or over, offered to the public between Jan. 1, 1919, and Dec. 31, 1919	6.15
(*b*) Average yield on nine representative issues of $1,000,000 and over, offered to the public between Jan. 1, 1920, and May 1, 1920	6.95

Of the total fund of capital available for investment in the United States today there is only a given amount available under any circumstances for railroads, public utilities, industrials, farm loans, real estate loans, certificates of deposit, savings bank accounts, stocks or government bonds. Thousands of individuals having considerable investment capital at their disposal would under no circumstances purchase a corporation security. Even a very high yield would not attract them. An illustration of this is found in the ability up to just a few months ago of the Federal Land Bank to float its farm loan bonds on a yield basis of 4½ per cent at a time when tax-free government bonds were being offered on a yield basis of close to 6 per cent. Investigation has shown that in a large measure these bonds were purchased in small lots by farmers and residents of small towns, individuals whose income is so small that the tax-free covenant in these bonds would have no particularly attractive force.

There are likewise thousands of individuals in the United States who have a strong preference for 6 per cent real estate loans. Still others have a strong preference for municipal securities. The result is that there are millions of dollars of available investment funds in the United States that would under no circumstances compete in the market for corporation bonds.

It is quite obvious from the abnormally high price

that public utility corporations have been compelled to pay for capital recently that investments of this type are rather generally considered as less desirable than many other classes of investments. There are two factors that seem to have been dominant in producing this situation.

First, public utilities because of their special and privileged position in the past took in some cases undue advantage of this position. The result was that thousands of small investors lost heavily in investments of this type.

In other cases some few of the public utilities abused their semi-monopolistic position and charged an excessive price for their services. Public opinion finally revolted and there were enacted various restrictive laws which so limited the control of public utilities over the selling price of their services as to place them entirely at the mercy of various rate-making bodies. Each of these two forces has had its period of ascendency, and as a result most public utility properties in the United States are in difficult financial straits. They are hampered by restrictive legislation and are suffering from what amounts in many instances to a financial boycott on the part of the investing public.

The problem today is to meet the existing situation. The abuses and prejudices of the past must be overcome. Public confidence in our public utilities must be restored. The service they render is a necessity and is in a large measure fundamental to the proper development of industry as a whole. A survey covering the investment field for public utility securities has clearly shown how serious the situation is at the present time. Every effort should be made to improve conditions lest the public be denied those services and facilities to which it is entitled. No improvement in this regard can be expected until public utility properties afford as attractive a field for capital investment as that offered in other fields of business enterprise.

TABLE VII—COST OF MONEY TO INDUSTRIALS EXCLUDING MARKETING PROFIT TO UNDERWRITERS
Period—Jan. 1, 1919, to May 14, 1920

	Yield, Per Cent
Average yield on five representative issues of $1,000,000 and over, offered to the public between Jan. 1, 1919, and July 1, 1919	6.23
Average yield on thirty-one representative issues of $1,000,000 and over, offered to the public between July 1, 1919, and Dec. 31, 1919	6.51
Average yield of eight representative issues of $1,000,000 and over, offered to the public in the month of January, 1920	6.60
Average yield of nine representative issues of $1,000,000 and over, offered to the public for February, 1920	6.62
Average yield of thirteen representative issues of $1,000,000 and over, offered to the public for March, 1920	6.92
Average yield of nine representative issues of $1,000,000 and over, offered to the public for April, 1920	7.42
Average yield of four representative issues of $1,000,000 and over, offered to the public up to May 14, 1920	7.17

Central-Station Expansion in 1920

Analysis of Returns Received Indicates That About 1,500,000 Kw. Will Be Added to Generating Capacity of Central Stations in 1920

IN SPITE of the unusually high cost of money, labor and materials, a substantial addition to the generating capacity and transmission lines of the electric light and power industry has been planned for 1920. While some new plants of large size are under way, for the most part the new equipment will simply mean additional plant and line facilities for systems already loaded to capacity. In certain sections of the country, especially in the East and far West, there has been an acute shortage of power. The new equipment will in most cases, therefore, merely act to help the utilities serve those whose needs are most pressing.

Generally speaking, the utilities are not undertaking any program of expansion except where necessity dictates. With money costing from 8 to 12 per cent, as at present, and other costs proportionately high or higher, the operators are not anxious to undertake a liberal expansion program.

In an endeavor to ascertain the extent to which the central stations are expanding during the present year, the ELECTRICAL WORLD has undertaken a survey of the central-station industry, the results of which are to be found in the accompanying tables. The number of companies rendering returns totaled 212, representing 54 per cent of the total installed capacity of the central-station industry. Of this number eighty-six, representing 15.8 per cent of the total installed capacity, reported no plans for additions in equipment during 1920. Of the remaining 42.2 per cent which reported definite plans for additions or improvements to their plants and transmission systems during 1920, about 30.5 per cent are steam plants and 11.7 per cent are hydro-electric. In only a few instances did the small plants contemplate additions, and it is probably safe to state that the total of $141,868,000 represents at least 80 per cent of the value of the total contemplated central-station new plant and additions and transmission-line extensions for the present year.

It will be noticed that several companies do not contemplate plant additions but are undertaking line extensions only, while others report both new generating units and transmission-line extensions. It is not a true indication, therefore, of the cost per kilowatt installed to divide the total value of all additions by the increased plant installation.

A summary of the proposed extensions shows a total

TABLE I—SUMMARY OF ADDITIONS TO CENTRAL-STATION CAPACITY AND TRANSMISSION LINES DURING 1920

Section of Country	Steam Plants											
	Capacity Jan. 1, 1920, Kw.	Proposed Additions to Plant Units, Kw.	Capacity Jan. 1, 1921, Kw.	Value of New Plant Units and Extensions in Transmission Lines	Capacity Jan. 1, 1920, Kw.	Proposed Additions to Plant Units, Kw.	Capacity Jan. 1, 1921	Value of New Plant Units and Extensions in Transmission Lines	Per Cent of Installed Capacity Represented	Total Additions in Plant Units, Kw.	Total Value of New Units and Extensions in Transmission Lines
New England	509,610	104,500	614,110	$8,630,000	188,200	34,225	222,425	$4,151,969	60	138,725	$12,781,969
Atlantic	2,059,171	323,800	2,382,971	43,608,000	758,635	112,800	871,435	9,116,000	65	436,600	52,724,000
South Central	259,257	29,600	288,857	2,567,000	177,900	.....	177,900	.....	45	29,600	2,567,000
North Central	1,069,825	373,375	1,443,200	37,893,232	323,513	14,325	337,838	1,215,200	34	387,700	39,108,432
Mountain and Pacific	442,265	61,458	503,723	5,976,855	1,124,957	186,500	1,311,457	28,709,591	86	247,958	34,686,446
United States	4,340,128	892,733	5,232,861	98,675,087	2,573,205	347,850	2,921,055	43,192,760	54	1,240,583	141,867,847
Total installed capacity of all central stations on January 1, 1920											12,760,000 kw.
Probable total installed capacity of all central stations on January 1, 1921											14,310,000 kw.

TABLE II—ADDITIONS TO CENTRAL-STATION CAPACITY AND TRANSMISSION LINES DURING 1920

Name of Company	Steam Plants: Capacity Jan. 1, 1920, Kw.	Steam Plants: Additions 1920, Kw.	Steam Plants: Value of Additions	Hydro-electric Plants: Capacity Jan. 1, 1920, Kw.	Hydro-electric Plants: Additions 1920, Kw.	Hydro-electric Plants: Value of Additions	Total Additions, Kw.	Total Value of Additions
SOUTH CENTRAL STATES:								
Choctaw Power & Light	9,000	.....	$120,000	.....	.....	.....	.....	$120,000
Dallas Power & Light	17,500	.....	650,000	.....	.....	.....	.....	650,000
Houston Lighting & Power Co.	14,500	8,000	450,000	.....	.....	.....	8,000	450,000
Jackson Railway & Light Co.	1,200	600	50,000	.....	.....	.....	600	50,000
Little Rock Railway & Electric Co.	13,600	5,000	310,000	.....	.....	.....	5,000	310,000
Memphis Gas & Electric Co.	14,000	14,000	812,000	.....	.....	.....	14,000	812,000
New Orleans Railway & Light Co.	58,700	.....	50,000	.....	.....	.....	.....	50,000
Southwestern Gas & Electric Co.	2,125	2,000	125,000	.....	.....	.....	2,000	125,000
Union Light, Heat & Power Co.	Included in United Gas & Electric report.						.....	.....
NORTH CENTRAL STATES:								
Beloit Water, Gas & Electric Co.	5,500	6,750	250,000	.....	.....	.....	6,750	250,000
Central Power Co., Grand Island	2,250	5,000	650,000	2,000	.....	.....	5,000	650,000
Kearney	750	.....	.....	600	1,500	$150,000	1,500	150,000
Cleveland Municipal Electric Light Plant	28,500	11,750	500,000	.....	.....	.....	11,750	500,000
Clinton Gas & Electric Co.	3,000	3,200	156,000	.....	.....	.....	3,200	156,000
Columbia, Delaware & Marion Electric Co.	4,250	7,000	950,000	.....	.....	.....	7,000	950,000
Columbus Railway, Power & Light Co.	48,310	7,500	750,000	.....	.....	.....	7,500	750,000
Consumers' Power Co.	72,250	27,500	7,000,000	76,610	.....	.....	27,500	7,000,000
Dayton Power & Light Co.	45,195	20,000	1,000,000	.....	.....	.....	20,000	1,000,000
Detroit Edison Company	199,300	109,000	8,000,000	4,475	.....	.....	109,000	8,000,000
Detroit Municipal Electric Light Co.	11,200	.....	800,000	.....	.....	.....	.....	800,000
Dubuque Electric Co.	11,150	.....	160,000	.....	.....	.....	.....	160,000
Illinois Northern Utilities Co.	6,600	3,000	200,000	3,000	.....	.....	3,000	200,000
Indiana & Michigan Electric Co.	13,250	9,500	275,000	14,750	4,000	182,000	13,500	457,000
Indiana Service Corp.	16,250	.....	50,000	.....	.....	.....	.....	50,000
Interstate Public Service	5,150	5,775	129,232	400	400	33,200	6,175	162,432
Iowa Railway & Light Co.	17,000	10,000	350,000	1,200	.....	.....	10,000	350,000
Kansas City Power & Light Co.	42,250	40,000	3,000,000	.....	.....	.....	40,000	3,000,000
Kansas City Municipal Electric Light Plant	20,000	.....	90,000	.....	.....	.....	.....	90,000
Lincoln Traction Co.	4,000	.....	50,000	.....	.....	.....	.....	50,000
Madison Light & Railway Co.	820	.....	1,000	.....	.....	.....	.....	1,000
Milwaukee Electric Railway & Light Co.	88,000	40,000	6,500,000	425	.....	.....	40,000	6,500,000
Moline-Rock Island Manufacturing Co.	42,500	.....	200,000	4,250	.....	.....	.....	200,000
Northern States Power Co.	59,280	.....	200,000	27,455	.....	.....	.....	200,000
Otter Tail Power Co.	1,285	1,500	150,000	4,275	.....	25,000	1,500	175,000
Peninsula Power Co.	3,200	.....	60,000	9,000	2,000	50,000	2,000	110,000
Richland Public Service Co.	10,000	10,000	350,000	.....	.....	.....	10,000	350,000
Richmond Municipal Light & Power Plant	4,250	5,000	300,000	.....	.....	.....	5,000	300,000
St. Cloud Public Service	2,500	3,500	600,000	2,200	.....	.....	3,500	600,000
St. Paul Gas Light Co.	8,000	.....	20,000	3,000	.....	.....	.....	20,000
South Illinois Light & Power Co.	1,750	2,000	100,000	.....	.....	.....	2,000	100,000
Superior Water, Light & Power Co.	1,700	.....	2,000	.....	.....	.....	.....	2,000
Terre Haute, Indianapolis & Eastern Traction Co.	11,500	7,500	600,000	.....	.....	.....	7,500	600,000
Union Gas & Electric Co.	101,000	30,000	2,700,000	.....	.....	.....	30,000	2,700,000
Union Light & Power Co.	2,150	.....	850,000	.....	.....	.....	.....	850,000
United Light & Power System:								
Riverside plant	2,100	.....	.....	650	350	50,000	350	50,000
Rocky Ford plant	1,400	2,900	150,000	1,400	2,800	200,000	5,700	350,000
Blue Rapids plant	.....	.....	.....	450	275	25,000	275	25,000
Wisconsin Public Service Co.	7,500	5,000	750,000	6,000	.....	.....	5,000	750,000
Wisconsin Valley Electric Co.	2,250	.....	.....	1,600	3,000	500,000	3,000	500,000
MOUNTAIN AND PACIFIC STATES:								
City of Tacoma Light Dept.	.....	.....	.....	24,000	.....	30,000	.....	30,000
Colorado Power Co.	4,775	1,475	135,000	26,900	.....	.....	1,475	135,000
Eastern Oregon Light & Power Co.	450	1,500	175,000	2,550	.....	30,000	1,500	205,000
Great Western Power Co.	26,000	.....	.....	65,000	44,000	8,500,000	44,000	8,500,000
Los Angeles Bureau of Power & Light	.....	.....	.....	30,500	30,000	2,750,000	30,000	2,750,000
Los Angeles Gas & Electric Corp.	22,908	13,333	681,480	.....	.....	.....	13,333	681,480
Pacific Gas & Electric Co., Phoenix, Ariz.	750	.....	250,000	.....	.....	.....	.....	250,000
†Pacific Gas & Electric Co.	117,000	12,500	950,000	194,875	1,000	2,096,200	13,500	3,046,200
Pacific Power & Light Co.	6,240	3,750	1,300,000	15,775	.....	.....	3,750	1,300,000
San Joaquin Light & Power Corp.	16,750	11,900	930,375	32,000	40,000	2,698,391	51,900	3,628,766
Seattle Municipal Light & Power Co.	22,500	15,500	1,250,000	14,875	15,000	1,075,000	30,500	2,325,000
Southern California Edison Co.	107,482	.....	.....	119,190	46,500	10,000,000	46,500	10,000,000
Utah Power & Light Co.	16,000	.....	.....	113,457	10,000	1,530,000	10,000	1,530,000
Wenatchee Valley Gas & Electric Co.	0	1,500	190,000	2,750	.....	.....	1,500	190,000
Western States Gas & Electric Co.	2,250	.....	.....	6,075	.....	.....	.....	.....
NEW ENGLAND								
Androscoggin Electric Co.	1,500	0	.....	6,500	2,250	$250,000	2,250	$250,000
Bangor Railway & Electric Co.	0	.....	.....	12,460	4,600	213,894	4,600	213,948
Cambridge Electric Light Co.	13,250	11,750	$450,000	.....	.....	.....	11,750	450,000
Central Maine Power Co.	10,375	.....	.....	15,650	10,750	1,300,750	10,750	1,300,750
Connecticut River Power Co. of N. H.	.....	.....	.....	20,000	8,000	1,000,000	8,000	1,000,000
Cumberland County Power & Light Co.	7,110	.....	.....	16,700	3,325	402,325	3,325	402,325
Danbury & Bethel Gas & Electric Light Co.	1,300	.....	100,000	.....	.....	.....	.....	100,000
Derby Gas Co.	10,000	5,000	350,000	600	300	35,000	5,300	385,000
Edison Electric Illuminating Co. of Boston	143,000	30,000	2,000,000	.....	.....	.....	30,000	2,000,000
Hartford Electric Light Co.	36,000	.....	150,000	1,600	.....	.....	.....	150,000
Holyoke Municipal Gas & Electric Light Plant	10,250	.....	125,000	.....	.....	.....	.....	125,000
Lynn Gas & Electric Co.	18,700	.....	200,000	.....	.....	.....	.....	200,000
Manchester, Traction, Light & Power Co., Nashua	1,500	.....	25,000	.....	.....	.....	.....	25,000
Meriden Electric Lighting Co.	5,250	3,000	100,000	.....	.....	.....	3,000	100,000
Narragansett Electric Lighting Co.	50,000	.....	1,000,000	.....	.....	.....	.....	1,000,000
New Bedford Gas & Edison Light Co.	52,000	20,000	1,850,000	.....	.....	.....	20,000	1,850,000
North Adams Gas Light Co.	2,000	3,000	150,000	.....	.....	.....	3,000	150,000
Pittsfield Electric Co.	5,000	5,000	750,000	.....	.....	.....	5,000	750,000
Rockingham County Light & Power Co.	14,500	.....	180,000	200	.....	.....	.....	180,000
Twin State Gas & Electric Co.	3,000	2,000	150,000	9,000	2,000	250,000	4,000	400,000

† Includes Pacific Gas & Electric, Northern California Power Co., Sierra & San Francisco Power Co.

(*Table II continued on page 520*)

TABLE II (CONTINUED)—ADDITIONS TO CENTRAL-STATION CAPACITY AND TRANSMISSION LINES DURING 1920

Name of Company	Steam Plants: Capacity Jan. 1, 1920, Kw.	Steam Plants: Additions 1920, Kw.	Steam Plants: Value of Additions	Hydro-electric Plants: Capacity Jan. 1, 1920, Kw.	Hydro-electric Plants: Additions 1920, Kw.	Hydro-electric Plants: Value of Additions	Total Additions, Kw.	Total Value of Additions
NEW ENGLAND:								
United Electric Light Co.	33,250	24,750	1,000,000	3,600	.....	.....	24,750	1,000,000
Vermont Hydro Electric Corp.	.....	.....	.....	7,600	3,000	700,000	3,000	700,000
Webster & Southbridge Gas & Electric Co.	6,200	.....	50,000	.....	.....	.....	.....	50,000
ATLANTIC STATES:								
Albany Southern Railroad	4,000	.....	.....	3,700	.....	250,000	.....	250,000
Appalachian Power Co.	18,750	20,000	1,000,000	25,000	.....	.....	20,000	1,000,000
Athens Railway & Electric Co.	3,500	.....	60,000	4,350	.....	.....	.....	60,000
Binghamton Light, Heat & Power Co.	9,500	5,750	.....	.....	.....	.....	5,750	.....
Consolidated Gas Co. of N. J.	2,000	.....	20,000	.....	.....	.....	.....	20,000
Consolidated Gas, Electric Light & Power Co.	80,000	20,000	1,500,000	600	.....	.....	20,000	1,500,000
Duquesne Light Co.	156,200	60,000	11,000,000	.....	.....	.....	60,000	11,000,000
Durham Traction Co.	3,300	.....	44,500	.....	.....	.....	.....	44,500
Edison Light & Power Co.	7,350	.....	21,000	.....	.....	.....	.....	21,000
Harrisburg Light & Power Co.	9,500	6,500	852,000	.....	.....	.....	6,500	852,000
Jamestown Municipal Electric Light Plant	2,000	3,000	250,000	.....	.....	.....	3,000	250,000
Kentucky & West Va. Power Co., Tug River District	7,125	3,750	250,000	.....	.....	.....	3,750	250,000
Miami Electric Light & Power	6,500	.....	800,000	.....	.....	.....	.....	800,000
Monongahela Valley Traction Co.	23,750	23,750	3,100,000	.....	.....	.....	23,750	3,100,000
Morris & Somerset Electric Co.	2,750	3,200	419,000	.....	.....	.....	3,200	419,000
Newport News & Hampton Railway Gas & Electric Co.	14,000	.....	75,000	.....	.....	.....	.....	75,000
New York Edison Co. and United Electric Light & Power Co.	467,000	22,000	1,600,000	.....	.....	.....	22,000	1,600,000
*Niagara Falls Power Co.	.....	.....	.....	285,000	100,000	8,000,000	100,000	8,000,000
Old Dominion Power Co.	2,000	.....	20,000	.....	.....	.....	.....	20,000
Orange & Rockland Electric Co.	2,175	3,000	200,000	.....	.....	.....	3,000	200,000
Orange County Public Service Corp.	3,575	.....	.....	1,200	400	18,000	400	18,000
Paul Smith's Electric Light & Power Co.	.....	.....	.....	3,000	.....	40,000	.....	40,000
Pennsylvania Utilities Co.	23,500	.....	175,000	2,100	.....	.....	.....	175,000
Philadelphia Electric Co.	260,504	60,000	10,000,000	.....	.....	.....	60,000	10,000,000
Public Service Electric Co, (New Jersey)	277,500	12,500	2,500,000	.....	.....	.....	12,500	2,500,000
Queensborough Gas & Electric Co.	8,700	.....	250,000	.....	.....	.....	.....	250,000
United Hudson Electric Corp.	.....	.....	.....	.....	5,000	450,000	5,000	450,000
United Service Corp.	24,250	8,500	1,100,000	1,600	.....	.....	8,500	1,100,000
Utica Gas & Electric Co.	13,250	7,000	400,000	21,200	6,400	300,000	13,400	700,000
Virginian Power Co.	47,500	23,750	900,000	.....	.....	.....	23,750	900,000
Virginia Railway & Power Co.	76,000	.....	.....	11,500	1,000	25,000	1,000	25,000
Virginia-Western Power Co.	4,500	.....	45,000	2,350	.....	.....	.....	45,000
Ware County Light & Power Co.	500	500	65,500	.....	.....	.....	500	65,500
Washington Railway & Electric Co.	87,000	.....	481,000	.....	.....	.....	.....	481,000
West. Penn. Railways System	98,328	40,000	6,100,000	105	.....	.....	40,000	6,100,000
Wilkes-Barre Co.	7,000	600	380,000	.....	.....	.....	600	380,000
York Haven Water & Power Co.	.....	.....	.....	.....	.....	25,000	.....	25,000

* This does not include the Canadian plant. Part of the addition given under 1920 was done in 1919.

addition of 1,240,583 kw. in generator installations. Assuming that this figure represents 80 per cent of the probable additions to all central stations during the present year, it appears probable that about 1,500,000 kw. will be added to the plant installation of 12,760,000 kw. as estimated by the ELECTRICAL WORLD for Jan. 1, 1920. The Atlantic States show the largest proposed expansion both in plant units and in total value. The Mountain and Pacific States reported by far the largest extensions by hydro-electric plants.

Electrically Operated Switchgear for Street-Lighting Control in Germany

THE city of Charlottenburg, which forms a part of Greater Berlin, has installed an interesting system of electric distance control for its street-lighting plant which enables the operator at the central station to flood the entire city with light in a minute's time. European conservatism does not permit the use of high-voltage arc-lamp series systems. Street-lighting practice over there consequently has to dispense with this labor-saving device and employ the old man-on-a-bicycle method for the switching service. Rising wages, however, have emphasized the poor economy of this practice, and the new machine switching system, whereby all switching is done from a control board in the main power house, is interesting as indicating what remarkably good economies may be obtained by installing such labor-saving electric control.

Charlottenburg is lighted by arc lamps, connected in series groups of three and fed from a 150-volt alternating current supply. The city is divided into several districts, with a number of lamp groups in each, and in every district there is a machine switching station, connected to the main control board by two circuits of No. 16 copper wire with a common ground return. Each switching station has a controller with cam contacts for the several lamp groups, different cams being provided for the all-night and for the half-night groups. The controller is rotated by a small motor, fed through one of the control circuits and operated by a switch on the central board. The other control circuit in each switching station is utilized for a telltale service with relays and signaling lamps, so that the operator at the control board is constantly informed about the position of each controller. Special trouble lamps are provided, which light up if any group of lamps goes out of service because of fault.

The operation simply consists in pushing the controller-motor switch until the signal lamps indicate that the controller has been rotated to the desired position.

The net cost of manual operation is estimated at 28,600 marks per year, but owing to the considerable time lag remote districts must be switched on earlier than illuminating conditions require, and a corresponding overshooting will occur in the mornings, resulting in an annual waste in carbons and kilowatt-hours to a value of 18,600 marks. The operators' salaries in the case of the electric remote-control system come to only 10,500 marks, to which amount must be added an interest of 7,800 marks and 1,500 marks for maintenance. The total costs thus compare as 47,200 to 19,800 in favor of the new control system.

Development of Electron Tubes—I

Various Arrangements of the Tubes Are Analyzed to Show What Conditions Are Necessary for Maximum Amplification—Historical Development of the Three-Electrode Tube Is Also Discussed

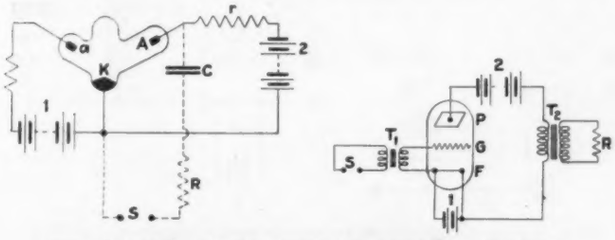
By MARIUS LATOUR,

Consulting Engineer, Paris, France

THE search for a relay without inertia that would amplify very weak currents has long occupied both physicists and engineers. Nor is the idea of utilizing the electrical phenomena in exhausted tubes containing an excited cathode (in form of an auxiliary arc or an incandescent filament) of very recent date. In recent years, however, the electron tubes have been developed to the point where they have assumed great commercial importance, pre-eminently in communication service, but also in the rectification of small and moderate currents and in measurement work. With the idea of setting forth the exact theory of these amplifying devices for the proper design of circuits in which they are used and also to show what has been contributed by the various investigators of the subject this discussion is offered.

As far back as 1905 Latour and Weintraub had conceived the idea[1] of utilizing the negative resistance of a specially designed mercury-vapor tube for purposes of amplification. The mercury-vapor tube used had a mercury cathode K and two anodes A and a (see Fig. 1, full line). a is the anode of an auxiliary arc fed by battery 1; the cathode K thus kept alive is a source of ions which insure the electrical conductivity of the tube throughout its whole volume. A battery 2 is connected to anode A through resistance r and is of such a voltage that an arc cannot establish itself so that only weak currents pass through the tube. Under these conditions Weintraub and Latour found experimentally that the potential drop between A and K for certain values of current decreases when the current increases (part ab of the curve, Fig. 3). For these weak currents the tube acts like a negative resistance.

Let us now introduce the tube thus constituted into a circuit containing a source S the reactance of which is compensated for the given frequency by the capacity C (see dotted circuit Fig. 1). The weak current generated by the source S is amplified, because the negative resistance of the tube tends to balance both the positive output resistance R and the internal resistance of the source. Theoretically, for nearly perfect balance there is no limit



FIGS. 1 AND 2—EARLY FORMS OF AMPLIFIER CIRCUITS

Fig. 1, full line, shows original circuit of Latour and Weintraub; Fig. 2, De Forest's audion.

to the magnitude of current that can be made to flow by ever so small a voltage. By a sufficient reduction of resistance R the total resistance of the circuit could even be made negative. In this case current could be obtained and spontaneous oscillations could be generated with voltage of the source S equal to zero. Experiments confirm this conclusion.[2]

The amplifier just described operates near the critical value at which spontaeous oscillations of the system start. This is a special case of a general principle that I had formulated in May, 1915,[3] and it is as follows: "Whenever free oscillations are possible an amplifying system is obtained when the critical value at which the oscillations start is approached."

Following a different line of thought, Lee de Forest proposed in 1907 a three-electrode amplifier named by him "audion."[4] Von Bayer in 1908 expressed similar ideas. The audion consists of an exhausted tube or lamp containing three electrodes (see Fig. 2): the filament F brought to incandescence by battery 1, the principal anode or "plate" P, connected to battery 2, and the auxiliary anode or "grid" G. in form, for instance, of a metallic gauze. The incandescent filament represents the "excited" cathode and replaces the auxiliary arc (*i.e.*, both the anode a and cathode K) of Fig. 1. By its incandescence it maintains the conductivity of the tube. The grid G introduced by De Forest is a new supplementary electrode.

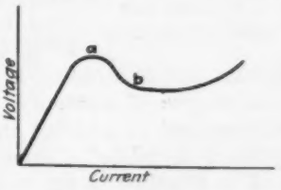


FIG. 3—CHARACTERISTICS OF ARRANGEMENT IN FIG. 1

Transformer T_1 brings the current to be amplified coming from source S to the terminals of grid and filament; transformer T_2 feeds the amplified current into the output resistance R.

The auxiliary electrode G is, so to speak, a control electrode, which causes the current between plate and filament to decrease or increase according to whether its potential with reference to the filament is negative or positive. One can compare the tube to a pipe line conveying a liquid and the grid to a valve alternately opened and closed by action of the alternating current to be amplified. The extent to which the valve is open is regulated by the potential impressed on the grid.

The Austrians von Lieben and Reids, undoubtedly influenced by the work of Latour and Weintraub, have, in 1911, designed three-electrode amplifiers containing an atmosphere of mercury vapor. The engineers of the General Electric Company in America have more recently constructed amplifiers in which the vacuum, on the contrary, is pushed as far as possible. The Western Electric Company has, on the other hand, developed amplifiers in which the vacuum is only moderate, but which contain an oxide-coated filament for the purpose of increasing the thermionic emission and consequently the conductivity of the space.

Finally, in the years preceding the war, German as well as American engineers published a number of different circuit connections for the three-electrode

[1] See U. S. patents Nos. 921,930 and 1,041,210 of 1907.

[2] Such a generator has been used by me for heterodyne radio reception instead of the three-electrode generator (Meissner).

[3] French patent No. 491,186.

[4] U. S. patent No. 841,387 describes it very explicitly.

amplifier. These publications undoubtedly anticipate some of the work done in France during the last few years. One must not forget, however, that the amplifier of audion type was little known in 1914 and that an exact theoretical study permitting from an engineering point of view the rational use of the apparatus was not at hand. It was under these conditions that the French Military Radio-Telegraphy Department, under the direction of General Ferrie, developed the amplifiers needed in its service. Mr. Abraham soon determined all the characteristics of the tube and all its useful constants. A special type was devised which offers the advantage of simplicity, ruggedness and cheap manufacture.

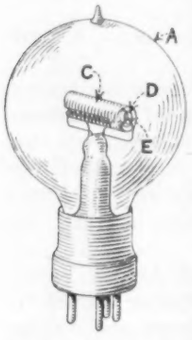


FIG. 4 — TUBE DEVELOPED FOR FRENCH MILITARY

In this type[5] (see Fig. 4), the filament, the grid and the plate are disposed concentrically and fastened directly to the leading-in wires, which are all sealed in the same glass tube fused onto bulb A. The filament E is placed in the center of the system and is attached to two conductors having a certain degree of elasticity. The grid g is in form of a wire wound in a spiral and supported at its ends. The cylindrical "plate" C surrounds the two other elements and is attached to its leading-in wire by means of one or two hooks.

Whatever the model used—*i.e.*, whatever the shape and dimensions of the electrodes or the degree of vacuum and the nature of the residual gases or vapors may be—it is always possible to establish general formulas for the rational calculation of the characteristics of the two transformers T_1 and T_2 as a function of certain easily measured constants of the tube.

A first approximation is obtained by treating the tube as a microphone. The variable potential applied to the grid causes a variation of the conductivity of the tube and on this basis the transformer T_2 is calculated by analogy with the induction coil of a microphone.

A second approximation is obtained by considering the tube as an alternating-current generator, the seat of an internal voltage proportional to the voltage impressed on the grid, the current being determined by the external resistance R and the internal resistance of the lamp.

I have treated these approximations mathematically in notes submitted to General Ferrie in 1915 and 1916 under the title "Optimum Output Resistance in Relay-Lamps."

This treatment, sufficiently accurate for most purposes, has since become classic. It happens, however, that the complete exact theory can be developed without great difficulty and that it is therefore not necessary to stop at approximations.[6]

Let I be the plate current. This current is a function of the plate potential V and the grid potential v, both measured with reference to a definite point of the filament (say the minus pole of the filament). Therefore one has

$$I = F(V,v)$$

The plate potential V, neglecting the resistance of the primary of the transformer T_2 in series with the plate, is equal to the voltage V_0 of the battery 2. The grid potential v can be assumed to be fixed in a similar manner by an auxiliary battery connected to the grid and in series with the secondary winding of the transformer T_1. In certain amplifier sets such a battery is actually used.

Let I_0 be the value of the plate-filament current for the values V_0 and v_0 of the plate and grid potentials.

For values I, V, v, in the neighborhood of I_0, V_0, v_0, the relation holds:

$$(I - I_0) = \left(\frac{\delta I}{\delta V}\right)_{\substack{v=v_0\\V=V_0}} (V - V_0) + \left(\frac{\delta I}{\delta v}\right)_{\substack{v=v_0\\V=V_0}} (v - v_0)$$

The coefficients of $(V - V_0)$ and $(v - v_0)$ are the partial derivatives of the above-mentioned function $I = F(V, v)$ for $V = v_0$ and $v = v_0$. These coefficients are easily determined experimentally. Maintaining the grid potential, v_0 constant, the variation ΔI of the current I_0 corresponding to the change ΔV of the potential V_0 is measured.

The quotient $\frac{\Delta I}{\Delta V}$ represents the value of $\left(\frac{\delta I}{\delta V}\right)_{\substack{v=v_0\\V=V_0}}$

Similarly, by maintaining the plate potential V_0 constant, the variation ΔI of the current I_0 corresponding to the variation Δv of the potential v_0, is measured. The quotient $\frac{\Delta I}{\Delta V}$ represents the value of $\left(\frac{\delta I}{\delta V}\right)_{\substack{v=v_0\\V=V_0}}$

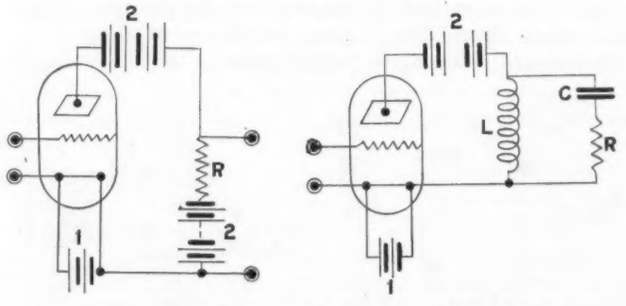
In a more general way, these coefficients are determined by tracing the curve $I = F_1(V)$ for a given v_0 and also the curve $I = F_2(v)$ for a given V_0 and drawing tangents to these curves at the point V_0 for $F_1(V)$ and at the point v_0 for $F_2(v)$.

The derivatives $\frac{\delta I}{\delta V}$ and $\frac{\delta I}{\delta v}$ have the dimensions of the inverse of a resistance; one can therefore put

$$\left(\frac{\delta i}{\delta V}\right)_{\substack{v=v_0\\V=V_0}} = \frac{1}{R_p}, \quad \left(\frac{\delta I}{\delta v}\right)_{\substack{v=v_0\\V=V_0}} = \frac{1}{R_g}$$

The subscripts p and g indicate that the corresponding resistances are related respectively to the plate or grid potential. One therefore derives

$$I - I_0 = \frac{V - V_0}{R_p} + \frac{v - v_0}{R_g}.$$



FIGS. 5 AND 6—MODIFICATIONS OF FUNDAMENTAL CIRCUIT OF FIG. 3

A similar analysis can be applied to the grid current $i = f(v, V)$ by putting

$$\left(\frac{\delta i}{\delta V}\right)_{\substack{v=v_0\\V=V_0}} = \frac{1}{r_p}, \quad \left(\frac{\delta i}{\delta v}\right)_{\substack{v=v_0\\V=V_0}} = \frac{1}{r_g},$$

and calling i_0 the grid current for the potentials v_0 and V_0, we derive the similar equation

[5] English patent No. 126,658 in the names of Biquet and Peri.

[6] The complete theory has been incorporated in my patents of March-April 1916. Other writers have since duplicated my work.

$$i - i_0 = \frac{v - v_0}{r_g} + \frac{V - V_0}{r_p}$$

If now we assume that $(v - v_0)$ corresponds to a very small alternating voltage u, $(i - i_0)$ becomes a very small alternating current j; $(V - V_0)$ and current J, amplifications of u and j. We have the two equations:

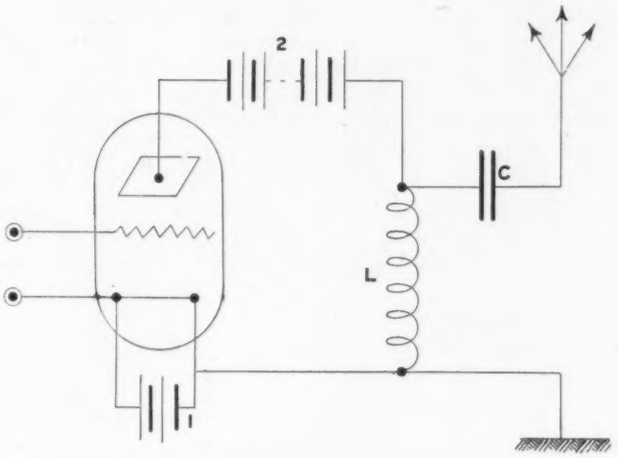
$$J = \frac{U}{R_p} + \frac{u}{R_g}, j = \frac{u}{r_g} + \frac{U}{r_p}$$

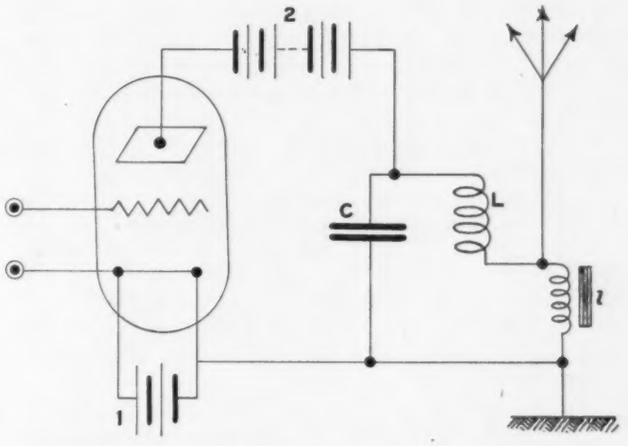
The value of the current J in the primary of the transformer T_2 is limited by the output resistance R across the secondary. Assuming an ideal transformer (magnetizing current, capacity and losses all zero), the equivalent resistance in the primary is equal to $\eta^2 R$, where η is the transformer ratio of T_2. From this follows:

$$U + \eta^2 RJ = 0.$$

We have thus finally arrived at the following system of equations:

$$J = \frac{U}{R_p} + \frac{u}{R_g}, j = \frac{U}{r_p} + \frac{u}{r_g}, U + \eta^2 RJ = 0$$





FIGS. 7 AND 8—CONNECTIONS OF TUBE FOR RADIO TRANSMISSION

which is solved by

$$i = \left[\frac{1}{r_g} - \frac{R_g \eta^2 R}{r_p R_g (R_p + \eta^2 R)}\right] u$$

$$U = -\frac{R_p \eta^2 R}{R_g (R_p + \eta^2 R)} u$$

$$J = \frac{R_p}{R_g (R_p + \eta^2 R} u$$

A comparison of the power uj supplied to the grid-filament circuit with the power UJ liberated in the plate-filament circuit shows whether a relay effect exists or not. For this ratio one finds

$$\frac{UJ}{uj} = rg \left[\frac{R_p}{R_g}\right]^2 \frac{\eta^2 R}{(R_p + \eta^2 R)\left[(R_p + \eta^2 R) - \frac{r_g R_p}{r_p R_g}\right]}$$

From this formula follows the important result that there exists a value of $\eta^2 R$ for which the relay effect is maximum. This value is given by

$$\eta^2 R = \frac{R_p}{\sqrt{1 - \frac{r_g R_p}{r_p R_g}}}$$

This means that the relay effect becomes maximum for a transformer ratio η of the transformer T_2 given by

$$\eta = \sqrt{\frac{R_p}{R\sqrt{1 - \frac{r_g R_p}{r_p R_g}}}}$$

For the tube developed by the French military telegraphy with a voltage of 70 to 100 impressed on the plate, one has the following values for the different resistances:

$R_p =$ 15,000 to 20,000 ohms,
$R_g =$ 2,000 to 3,000 ohms,
$r_g =$ 250,000 to 400,000 ohms,
$r_p =$ 50 to 100 megohms.

In general, for most tubes, the ratio $\frac{r_g R_p}{r_p R_g}$ is small compared to unity, so that the value of η for optimum is $\eta = \sqrt{\frac{R_p}{R}}$, where R_p is preferably given the larger value.

The transformer T_2 is thus perfectly determined. If it is desired that the transformer operate with a good power factor (as we have assumed by hypothesis), its open-circuit reactance (secondary open) at the given frequency must be made large in comparison to $\eta_2 R$. In practice for 800 cycles it is enough to make the reactance two or three times larger than $\eta_2 R$. It is easily shown that if this reactance is chosen too small, the conditions are improved by increasing the value of η. For the weak inductions prevailing here the permeability of the magnetic circuit is of the order of 200. The volume of the transformer is mainly dependent on the amount of insulation considered sufficient. Enameled wire or wire with one layer of silk will naturally lead to a much less voluminous transformer at the same efficiency than a wire with two silk layers or with cotton insulation. On the other hand, in small volume transformers the windings are closer, the effect of their capacity therefore greater, and the danger of speech distortion more serious.

CALCULATION OF TRANSFORMER IN GRID CIRCUIT

Let us now determine the transformer ratio for transformer T_1. The amplified power UJ is, other things being equal, proportional to uj; it is therefore desirable

to give uj the maximum possible value; in other words, to extract from the source S the maximum power. To accomplish this it is necessary to make the apparent grid-filament resistance, measured by its effect in the primary of transformer T_1, equal to the impedance Z of the source. From the equation of the grid current j, one finds the apparent grid-filament resistance equal to

$$Y = r_g \frac{R_p + \eta^2 R}{R_p + \eta^2 R \left[1 - \frac{r_g R_p}{r_p R_g}\right]}$$

Assuming $\frac{r_g R_p}{r_p R_g}$ very small, one finds $Y = r_g$. Under these conditions the transformer T_1 should have a ratio η^1 such that

$$(\eta^1)^2 Z = r_g, \ \eta^1 = \sqrt{\frac{r_g}{Z}}$$

Always supposing $\frac{r_g R_p}{r_p R_g}$ small, the expression of the relay effect given above becomes for $\eta^2 R = R_p$:

$$\frac{UJ}{uj} = \frac{1}{4}\left(\frac{R_p}{R_g}\right)^2 \frac{r_g}{R_p}$$

To have a large amplifying effect the tubes must be so designed as to give the largest possible value to the quotient R_p/R_g and to possess as low an internal resistance R_p as possible (tubes with strong thermionic emission). Taking the grid potential for one's starting point, one can say that the tube behaves like an alternator of internal resistance R_p and internal electromotive force $\frac{R_p}{R_g} u = ku$ (the Americans call this quotient, k, the "amplification constant").

This simple interpretation is the one now generally used by American writers on the subject; it is also the one I had adopted in the note of January, 1916, mentioned above.[7]

The battery voltages 1 and 2 do not enter directly into the above expression of the relay effect. They enter, however, indirectly by modifying the values of R_p, R_g and r_g.

An increase in the voltage of battery 2 does not therefore necessarily cause greater amplification. Instead of an amplifier of power utilizing transformers T_1 and T_2, one can obtain a *voltage* amplifier by simply placing in series with the plate circuit a resistance R, as shown in Fig. 5.

In this figure the battery 2 is shown as subdivided into two parts, 2′ and 2″, in such a manner that at rest the voltage of battery 2′ just compensates for the ohmic drop in resistance R. In such a "resistance coupled" amplifier one has the following two equations:

$$J = \frac{U}{R_p} + \frac{u}{R_g}, \quad U + JR = 0,$$

from which one derives:

$$U = -\frac{R_p}{R_g}\left(\frac{R}{R_p + R}\right) u$$

As the resistance R increases, the ratio U/u is seen to approach the limit $R_p/R_g = k$, provided that battery 2″ is kept constant and battery 2′ is constantly adjusted so as to compensate for the ohmic drop in R.[8]

In what precedes we have made no assumption as to the frequency of the current that is to be amplified. Ordinary transformers with an iron magnetic circuit can therefore be used in the amplification of radio-reception currents. Special precautions must, however, be taken in the construction of the transformer to reduce the capacity effect between the different turns and separate layers of the winding; otherwise, the number of turns being rather larger, the capacity may assume such a dangerous value as to obliterate the transformer action. It is also necessary in order to obtain satisfactory efficiency to use very thin iron sheets—0.07 mm. or 0.08 mm. thick—or iron wire 0.10 mm. to 0.15 mm. in diameter. With these precautions I have constructed apparatus serviceable at the highest frequencies.

In case of very high frequency one may, however, dispense with the transformer in the plate circuit and use instead a combination of inductance and capacity in shunt (see Fig. 6). The output resistance is then placed in series with one of these elements.

For these connections I have shown some time ago (1915) that for a given R and a given oscillatory potential impressed on the grid there exists a definite ratio L/C which makes the amplified power maximum. This ratio is determined by the condition that the apparent resistance of the L-C circuit be of the order of magnitude of the internal resistance R_p of the tube.

In order that the combination L-C shall behave like a resistance, the relation

$$1 = \frac{\omega^2 CL}{2} + \frac{C\sqrt{L^2\omega^4 + 4R^2\omega^2}}{2} \qquad (1)$$

must be verified.

This condition being fulfilled, the apparent resistance is equal to

$$R + 1/C^2\omega^2 R. \qquad (2)$$

If R is small compared to $L\omega$ or $1/C\omega$, relation, (1) becomes the condition of resonance and the value of the apparent resistance (2) becomes L/CR. We thus arrive at the result that L/C must be independent of the frequency and must satisfy the equation $L/CR = R_p$. Resistance R may be represented by the antenna as shown on Fig. 7.

The resistance R may also be introduced into the inductance branch. When this resistance is the antenna itself I have suggested the use of a coil l with iron core, which lets the direct current of the plate circuit pass but opposes a large impedance to the high-frequency current (Fig. 8).[9]

A station of large power obtained through amplification of a smaller power controlled by a microphone or other means is assumed here. The controlling power can be brought up, as I have suggested, by means of a transformer with an iron magnetic circuit.

This discussion, which is a translation by Dr. E. Weintraub of a lecture before the Société Française des Electriciens, will be completed in an early issue.

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[7] This interpretation was omitted in my article in the London *Electrician* of Dec. 1, 1916, in order not to make public the constants of the tubes used by the French military telegraphy.

[8] Resistance-coupled amplifiers have been used in America by White. Multistage amplifiers of greater interest have been developed in France by Beauvais and Brillouin, and also by Abraham and Block.

[9] The antenna connections of Figs. 7 and 8 were proposed by me in 1915. The connections of Fig. 7 are anticipated by a patent granted to Marconi in 1914. They are the ones usually employed. The connections of Fig. 8 are, however, also of interest.

Survey of New England Power Situation

Analysis of Reports Received by Power Section of War Industries Board Indicates Total Production of More Than 5,000,000,000 Kw.-Hr. by Central Stations During 1924—Estimated Increase of 1,400,000 Kw., 1919-1924 Inclusive

By MAJOR CARROLL H. SHAW

Formerly in charge of the New England District of the Power Section of the War Industries Board

SOON after the organization of the Power Section of the War Industries Board early in 1918 it became evident that a power shortage might be expected in New England. The industries and public utilities had already suffered severely from the restrictive order of the Fuel Administration which became effective early in 1918, in accordance with which it was necessary for nearly all manufacturing industries to close down for stated periods. This order was due to the inability of the railroads to handle the freight and coal offered to them and also to the lack of sufficient coal for the war-essential industries throughout the country.

Great difficulty was experienced by nearly all of the utility companies in securing coal to continue the operation of their stations. Fortunately, however, the situation did not become as critical in New England as in Ohio and Pennsylvania, where, in a number of cases, the plants had to be shut down because of the lack of coal. None of the New England utilities was obliged to close down because of the difficulty of securing sufficient coal.

The result of a preliminary survey among the utilities throughout New England in the spring of 1918 showed that either the existing equipment of the isolated operating companies would be sufficient to handle all of the anticipated load for the winter of 1918-1919, or that the new equipment which had been ordered would give them sufficient capacity. Among the larger power companies, however, there was need for much additional generating equipment, which was to be obtained in part by the completion of the generating plant of the Eastern Connecticut Power Company, south of Norwich, Conn.; by the addition of a 40,000-kw. turbine by the Narragansett Electric Lighting Company at Providence, and a 10,000-kw. turbine by the New England Power Company at Uxbridge, Mass. These additions were to become more generally available through further interconnection of the respective systems by means of high-tension transmission lines.

ESTIMATES

In preparing estimates of the power and energy requirements of the New England States for the next five or six years it has been assumed that the normal growth of each class of business will continue in the manner indicated by the records of previous years. Detailed information was obtained from all of the public utility companies covering their operations for the years of 1915, 1916, 1917 and 1918, and in addition to this, data contained in Census Bureau reports as far back as 1869 were made use of.

Table I shows in combined form the actual and estimated future installed rated capacity and energy production of all of the manufacturing and utility power plants in New England for the years between 1915 and 1924 inclusive. By utilizing the Census reports on electric light and power plants for 1907, 1912 and 1917 in conjunction with the reports received from individual companies, it has been possible to determine the normal increment of output of the electric light and power stations during this period. With these data it has been possible to estimate the total amount of energy that may be expected to be generated by these stations during the following five years.

After having estimated the probable annual energy production that will be required of electric light and power stations from 1919 to 1924 inclusive, it has been possible to determine how much additional generating capacity will be required to enable these stations to produce the increase of output. It has been found that very little new steam generating equipment will be put in by street railways except for the new 25,000-kw. turbine installed by the Boston Elevated Railway during 1919, and as some obsolete equipment now carried on the records as installed capacity will be abandoned it has been assumed there will be no increase of the rating of street railway generating equipment after 1919.

A careful study of the records which are available

TABLE I—INSTALLED RATING AND OUTPUT OF NEW ENGLAND POWER PLANTS

Source	Installed Rating—Thousands of Horsepower						Output—Millions of Kilowatt-Hours					
	1915	1918	1919	1920	1921	1924	1915	1918	1919	1920	1921	1924
Steam: Street railways	449	466	490	490	490	490	619	600	630	630	630	630
Electric light and power	765	1,027	1,225	1,440	1,710	3,140	752	1,311	1,467	1,764	2,095	3,852
Railroads	50	50	50	50	50	50	101	78	77	77	77	77
Manufacturers	1,900	1,975	1,985	2,000	2,015	2,030	2,480	2,580	2,580	2,610	2,640	2,660
Total	3,164	3,518	3,750	3,980	4,265	5,710	3,952	4,569	4,754	5,081	5,442	7,219
Hydro: Street railways	45	45	48	48	48	48	11	11	12	12	12	12
Electric light and power	304	432	492	549	625	775	568	863	1,054	1,177	1,340	1,665
Manufacturers	758	758	758	760	765	780	1,490	1,490	1,490	1,492	1,50	1,532
Total	1,107	1,235	1,298	1,357	1,438	1,603	2,069	2,364	2,556	2,681	2,8542	3,209
Internal-combustion engines:												
Electric light and power	6	10	.....	.....	.....	.....	....	...	....	....	....	.....
Manufacturers	50	60	.....	.....	.....	.....	....	....	....	....	....	.....
Total	56	70	.....	.....	.....	.....	....	....	....	....	....	.....
Total installation	4,327	4,823	*5,048	*5,337	*5,703	*7,313	6,021	6,933	7,310	7,762	8,296	10,428

*Internal-combustion engines not included.

*This is an extract of a report on an investigation of the power service of New England by Major Carroll H. Shaw, Engineers, made during the latter part of 1918 and the first part of 1919, under the authority of the Power Section of the War Industries Board of the War Department, the investigations of which Frederick Darlington, consulting engineer, had general supervision. Major Shaw is now consulting engineer with the engineering firm of Jackson & Moreland of Boston.

indicates that very little, if any, increase can be expected in energy production by street railways, electrified railroads, or manufacturing establishments in either steam, hydraulic or hydro-electric power.

Apparently, the electric light and power companies are the only class of business that will continue to maintain a substantial increase. The inherent advantages of electric power and the large economies that can be secured from super-power stations indicate the probability of energy production becoming more and more a specialized industry, not necessarily financially interrelated with power transmission and distribution companies.

The most important factor in the production of steam-electric energy is the supply and utilization of coal. A summary of the returns made by the electric light and power companies showed that their total consumption of coal in 1918 was approximately 1,610,000 net tons and that from 1,606,226 tons of this total they produced 1,283,154,000 kw.-hr. This leaves a net balance of 28,227,000 kw.-hr. unaccounted for in the total

TABLE II—ESTIMATED INVESTMENTS BY CENTRAL STATIONS FOR NEW INSTALLATIONS

Year in Which Investment Is Made	—Hydro-Electric— 1,000 Kw.	Cost per Kw.	Investment, (Thousands of Dollars)	— Steam Turbine *— 1,000 Kw.	Cost per Kw	Investment (Thousands of Dollars)	— Total Increase — 1,000 Kw.	Cost per Kw.	Total Investment (Thousands of Dolls.)
1919	37	260	9,620	144	110	15,840	181	141	25,460
1920	57	250	14,250	100	100	10,000	157	154	24,250
1921	40	250	10,000	150	100	15,000	190	132	25,000
1922	38	250	9,500	300	100	30,000	338	117	39,500
1923	42	250	10,500	340	100	34,000	382	116	44,500
	214	$252	$53,870	1,034	$101	$104,840	1,248	$128	$158,710

* The above estimate does not include the cost of transmission lines or substations.

of electric energy generated by steam in electric light and power stations for that year.

A careful study has been made of the individual coal consumption of each of the steam stations in the electric light and power class, from which it has been found that 685,000,000 kw.-hr. (approximately half the total) were generated in 1918 by the consumption of 685,000 net tons of coal, indicating an average efficiency of 2 lb. of coal per kilowatt-hour.

If the entire energy production of steam stations in 1918, which amounted to 1,311,481,009 kw.-hr., had been produced at an average rate of 2 lb. of coal there would have been 1,311,481 tons of coal required, indicating a possible saving at this assumed coal rate of approximately 300,000 tons; but as a very considerable portion of this coal was used at efficiencies closely approximating 2 lb. per kilowatt-hour and as one of the larger and most inefficient stations is to be immediately superseded by a new hydro-electric development, the actual feasible saving which might be looked for in these electric plants can hardly exceed 150,000 tons.

Probably the largest single class of coal consumer in New England is the steam railroad. Conservation of fuel by means of railroad electrification offers tremendous opportunities. Adopting the estimate of the Fuel Administration that the New England steam railroads consumed 7,800,000 net tons of coal in 1918, and assuming that electrification of trunk lines would displace 5,000,000 tons with electric power, it seems probable that a net saving of 60 per cent of this 5,000,000, *i.e.*, 3,000,000 tons, could be secured. This estimate is based upon the further assumption that electrical energy could be delivered to the electric locomotives at a net coal consumption of 2 lb. per kilowatt-hour and that the average saving over locomotive coal consumption would be 60 per cent. The records of the N. Y., N. H. & H. R.R. indicate that at this 2-lb. rate the savings in the various classes of service would be as follows: (1) Express passenger, 59 per cent; (2) local passenger, 76 per cent; (3) fast freight, 63 per cent; and (4) slow freight, 58 per cent.

FUTURE DEVELOPMENTS

An estimate of the future development of power production in New England is to all practical purposes an estimate of the future development of the electric utility industry. Nearly all increases of power production from other sources have ceased. The total output of central electric power stations during 1918 was 2,174,000,000 kw.-hr. and it has been estimated that during 1924 it will have increased to 5,517,000,000 kw.-hr. The installed generating capacity of electric stations in 1918 was 1,050,000 kw. The total capacity that will be required for the 1924 output will be approximately 2,500,000 kw., indicating that nearly 1,400,000 kw. of combined steam and hydro-electric generating capacity must be added if the estimated increase in output occurs. Table I shows the estimated values of installed capacity and energy output for 1921 and 1924.

Table II indicates the probable net investment that will be required to provide for these additional capacities. During the period just preceding the war it was possible to construct large steam-electric power stations at from $60 to $70 per kilowatt, but during the period of the war this cost increased in some cases of record to $125 per kilowatt. At the present time the cost is probably still higher. A study of this table indicates that nearly $11,000,000 a year may be absorbed by the construction of hydro-electric plants and that more than $20,000,000 will be spent for steam-electric stations.

An estimate has been made of the undeveloped hydro-electric projects in New England that appear to be feasible—*i.e.*, that appear to offer, either now or in the near future, such opportunities for development as to make them financially profitable. The total additional hydro-electric power that will be available after 1919 is figured at 323,000 kw., and it is estimated that this new power would produce 1,378,000 kw.-hr. per annum, under usual operating conditions. The estimated probable installation of additional hydro-electric capacity which may be expected to take place after 1919 through 1924 is 214,000 kw., from which it is evident that after the above additions have been made there will remain only about 109,000 kw. of undeveloped hydro-electric power which it appears feasible to attempt to use.

The increase in production of hydro-electric energy by electric power stations during 1924 is estimated at 863,000,000 kw.-hr. more than during 1918, but as the total estimated available and feasible increase in energy production from hydro-electric units, including that becoming available during 1919, has been figured as only 1,496,000 kw.-hr., it will be seen that after 1924 there will remain a net available annual production of only 633,000,000 kw.-hr. per year from feasible undeveloped hydro-electric projects.

If the annual increase in output of the New England electric light and power stations continues at the rate of more than 15 per cent, as has prevailed for more than six years, further extensive interconnections by means of high-tension transmission lines between large power stations and manufacturing districts must be accomplished. At the present time there are but five steam-electric generating stations which operate at an efficiency of 2 lb. of coal per kilowatt-hour or better. The new stations of the Turners Falls Power & Electric Company at Chicopee and of the Eastern Connecticut Power Company below Norwich will undoubtedly be able to produce energy at the 2-lb. rate under reasonable load factors. The five most efficient utility stations mentioned above are located at Providence, R. I.; New Bedford, East Bridgewater, Boston, and Salem, Mass.

A study of the reports of the various companies in the western half of Connecticut indicates that a modern super-power station should be developed in that territory. Assuming a possible location intermediate between Bridgeport and New Haven, it is probable that a development of nearly 300,000 kw. will be required in this territory by 1924 if the additional increase in steam-electric energy that has been estimated occurs. A similar development of 300,000 kw. may be made along the northeastern shore of Massachusetts or in New Hampshire, possibly at Salem, Newburyport or Portsmouth.

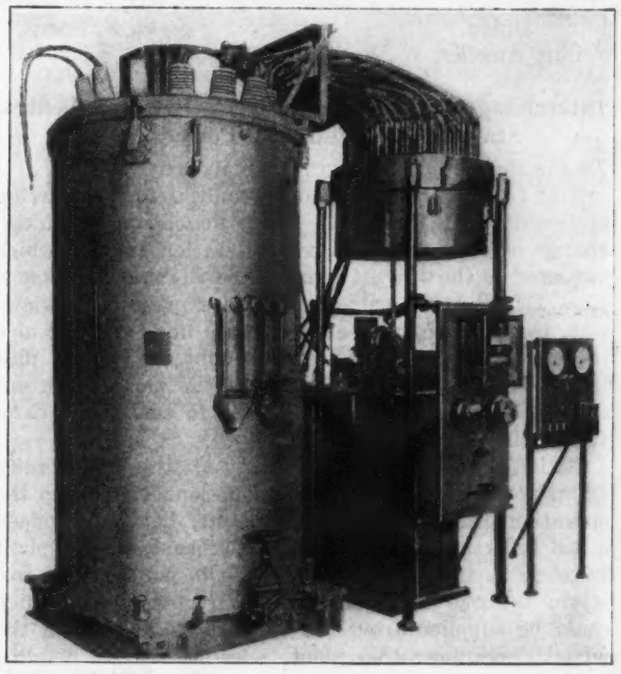
The total estimated addition in steam-electric stations is 1,152,000 kw. An increase of 60,000 kw. over and above the present contemplated addition at Boston, 50,000 kw. addition at Providence, 75,000 kw. at New Bedford, 70,000 kw. at Norwich and 75,000 kw. at Chicopee would provide, together with the two new stations above, approximately 1,000,000 kw., and these assumed additions are located in those territories where a large increase in electrical energy consumption is anticipated.

The generation of such tremendous quantities of electrical energy from steam stations will mean the consumption of much larger quantities of fuel than has heretofore been contemplated. The increasing use of fuel oil in the operation of steam stations has become of considerable interest to the utilities recently and will undoubtedly become a very important factor in the construction and operation of steam stations. The possibilities of storage of oil without attendant depreciation and the facility with which it may be handled make it particularly desirable for steam stations that may be operated only as reserve units.

To summarize the work of the survey, except for slight increases in large isolated industrial plants, practically no increase in generating capacity may be expected in the future except for electric light and power companies. The efficiency of the super-power stations in the generation of electrical energy indicates clearly that this method of power production must prevail over former methods. The recent falling off in the growth of isolated-plant power production indicates that the isolated plants are no longer to be the principal source of power for manufacturing industries. Electrical energy produced in modern, efficient generating stations, operated both by steam and by water power, delivering their product to high-tension electric transmission systems, and interconnected in such a manner that there exist numerous reliable power sources, apparently is to become the universal method of furnishing power for manufacturing purposes. The investment that will be required to provide this additional generating equipment and the attendant transmission and distribution lines will be very large. There still remain a comparatively large number of small systems that should abandon their generating stations and obtain their electrical energy through the high-tension transmission lines that are connected to the most efficient generating stations.

Combined Electric Resistance Furnace and Control Unit

RESISTANCE furnaces and furnaces requiring a variable voltage supply are rapidly increasing in number, and are now employed with graphite, brass, zinc and carbon-bisulphide and for heat treating and numerous other uses. It has been found that one of the most satisfactory means for supplying power to a furnace of the resistance type is the use of a combination step and induction regulator. This consists principally of a furnace transformer with taps in the primary winding and an induction regulator for bridging between the voltages given by the transformer taps. With this combination a continuous voltage without breaks can be obtained over a wide voltage range. A complete unit for this service consists of a furnace transformer, an induction regulator, a selector switch, a transfer switch, a series transformer and a panel containing the necessary meters and control for the equipment.



1,100-KVA. STEP INDUCTION FURNACE-REGULATOR EQUIPMENT

An 1,100-kva. equipment of this type built by the Westinghouse Electric & Manufacturing Company is shown in the illustration. This is one of twenty equipments that were recently manufactured for service on zinc furnaces to be installed in Norway. This information was brought out in a paper by Philip B. Short at a recent meeting of the American Electrochemical Society.

Readers' Views and Comments

Electric Stove in Service Twenty Years

To the Editor of the ELECTRICAL WORLD:

SIR: I have a little three-heat hot plate about the size of a saucer and two inches high that I have made my coffee on for twenty years, and I have just burned it out for the first time, by accidentally placing it on a 220-volt circuit. Being an electrician by trade, I took it apart with a view to repairing it and found the elements set in porcelain and stamped "May 8, 1899, made by American Electric Heating Corporation, Boston, Mass., 110 V.-1.9A." I think mine is about the oldest hot plate in existence and, with never a cent for repairs, I'll venture to say it has been in actual service 10,000 hours and has used 1,650 kw.-hr. of electricity at an average rate of 10 cents, totaling $165 worth of electrical energy. It has used energy in thirty-two states of our Union.

W. F. BOGGS.

Port Angeles, Wash.

Interchange of Electrical Energy Between Central Stations and Industrial Power Plants

To the Editor of the ELECTRICAL WORLD:

SIR: In view of the large opportunities for fuel saving disclosed by C. E. Weber in an article on the interchange of industrial and central station energy, which appeared in the July 24 issue of the ELECTRICAL WORLD, page 173, it is desirable for all to express their views who, by their experience along these lines, may be able to help bring about the results sought. With this idea in mind, I have set down some of the more important considerations which have occurred to me after a careful reading of the article.

It is quite generally known that the opportunity exists for a large saving of fuel in connection with the operation of industrial power plants, but it is indeed a sad reflection on power-plant engineers when a plant is taken as typical in which 5,000 lb. per hour of live steam is used for low pressure requirements which could be supplied from the exhaust available. In the writer's opinion, the plant selected for a detailed analysis is not typical. From our observations, which cover a large number of industrial power plants, we know that there are few plants indeed where exhaust steam is wasted to the air when it could be utilized in process work. In unusual cases only have we found plants which are operating power-generating units condensing when exhaust steam could be utilized in heating or process work.

That a considerable saving can be effected by the interconnection of industrial and other plants with the lines of a central station and the resultant interchange of electrical power has been recognized by central-station companies or their subsidiaries in some of our larger cities. Plant-operating agreements have been made under the terms of which such interchange of power is provided for. In cases where the central station has been unable to increase its capacity as rapidly as the demand for power has increased or where there is particular fear of a shutdown, due to coal shortage, such interconnection and interchange is particularly attractive from the standpoints of both the public and the utility company, and in such cases agreements of this kind are not uncommon.

There are many limitations to a general extension of this plan. We will call attention to them so that in subsequent discussions there may be brought forward suggestions by which these limitations could be removed. At the present time the application of uniform rate schedules for the sale of electric power is quite general. Under the terms of most of these schedules it would not be advantageous for an industrial power plant of any considerable size to purchase its power over the summer months for, by so doing, it would be able to balance only the cost of fuel and labor saved against the cost of power purchased, and it is very seldom that the cost of buying power would work out cheaper under these conditions. On the other hand, the average central station would not be interested in the purchase of power from an industrial power plant unless the rate were such as to compare favorably with what might be termed "the variable coal cost per kilowatt-hour." Limitations of lesser importance but which tend to restrict the application of the idea are:

1. Direct current generating equipment is still extensively used in industrial power plants. Rotary converters would be required in such cases. Large fixed charges and continuous losses are then brought into the problem.

2. In order for the central station to be interested special protective devices would have to be installed to insure freedom from interruptions, and the question arises as to who will buy and maintain this equipment.

3. The fact is that in all but the very large industrial power plants the operating conditions cannot be foreseen with any degree of accuracy, with the result that the central station could not depend upon these interconnections to carry a portion of the load at any definite time.

The limitation as to existing rates could be overcome if state railroad commissions would approve special contracts, covering individual cases upon the recommendation of engineers employed by both parties to the contract, provided there is sufficient opportunity to save fuel to warrant an agreement for the public good and provided at the same time that the contract would be profitable to the contracting parties.

In our opinion, there will be some tendency in this direction in large communities on the part of large industrial power plants where the electric demand exceeds 1,000 kw. and the floor space occupied exceeds 200,000 sq.ft. and where the demand for steam for process work is a considerable item. There are many small communities where there are several industrial power plants whose capacity compares favorably with that of the central station, and in these cases a plan such as Mr. Weber suggests would work out advantageously. There will also be an increasing tendency along this line in the case of hotel and office building electric and heating plants. In any case, it is clearly the duty of the consulting engineer who installs the industrial power plant to provide the same characteristics of current, frequency and voltage as are supplied to the district from the lines of the central station company.

S. J. GATES,

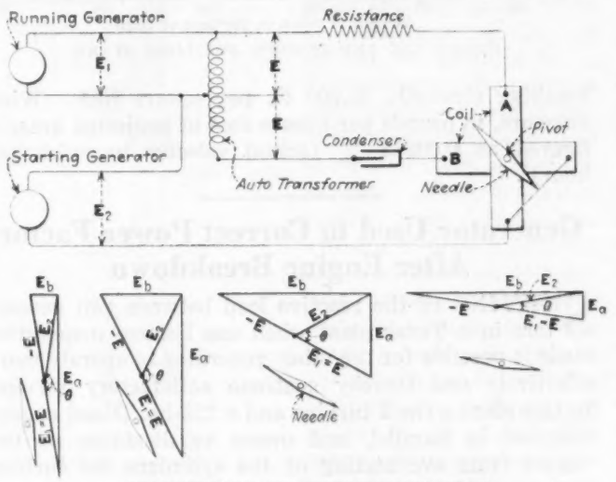
Milwaukee, Wis. Gates Engineering Company.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Easily Constructed Synchroscope for Instruction Purposes

AN EASILY and cheaply constructed synchroscope which may be used by laboratories where the expense of a regular manufactured instrument is not warranted is shown in the accompanying drawing. This consists essentially of two coils, *A* and *B*, each wound with a few turns of small wire, placed at right angles



CONNECTIONS FOR SIMPLE HOME-MADE SYNCHROSCOPE

to each other. Above the center of these coils is pivoted a needle of soft iron. For this a demagnetized and annealed compass needle serves well. The two coils are connected to the extremities of an auto-transformer respectively through a resistance and a condenser. A center tap of this auto-transformer is connected to the common lead from the running generator and the generator to be started. The other connections of the generators are as indicated.

When the connections are made as shown in the drawing the needle will revolve until the machines reach the same speed. When they are at the same speed the needle will stand still, and when the needle points parallel to the axis of the coil *B* the generators are in synchronism. Provided the voltages are the same, the generators may now be connected in parallel.

To understand the reason for the rotation of the needle the vector diagram must be consulted. In this diagram E_1 and E_2 represent the respective generator voltages. E_b and E_a represent voltages across coils *B* and *A*, and the angle θ is the difference in angle between the voltages at any instant. Neglecting inductance and resistance of the coils, it is seen that the magnetic flux linking the coils varies as the voltage across the coils.

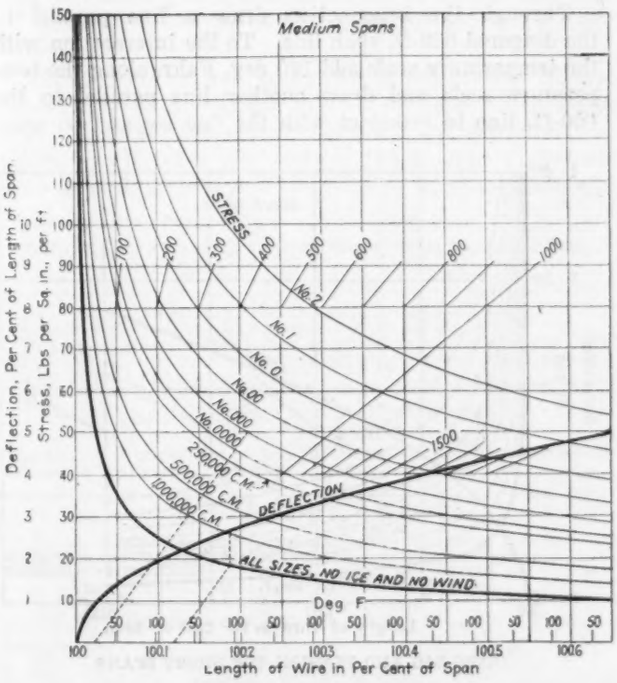
As the angle θ becomes smaller, as shown in the small diagrams, the voltage E_b increases and the voltage E_a decreases. The needle consequently swings in the direction of *B*, and when θ is zero it lies along the axis of *B*.

LESLIE F. CURTIS.
University of Washington,
Seattle, Wash.

Charts Show Tension and Sag for Transmission Lines

TO FIND the proper sag and tension to give a line when stringing so that the allowable stress will not be exceeded in cold or windy weather, as well as to determine what sag will correspond to any given tension under present conditions, the charts shown here have been prepared. The values for deflection are shown in per cent of the span length, while the stress is in pounds per square inch per foot of span length. The chart also gives the length of wire in per cent of the span length.

Suppose, for example, it is desired to find the sag in a span 600 ft. (180 m.) long with an average tension on



FOR CALCULATING SAG AND TENSION WITH OR WITHOUT ICE AND WIND

the wire of 30,000 lb. per sq.in. (2,100 kg. per sq.cm.). This is a tension of 50 lb. per ft. (72 kg. per m.) of line length. Therefore, on the chart for medium spans, from the "50" on the stress scale draw a horizontal line to the right until it intersects the heavy "no ice and no wind" curve. From this intersection drop vertically

to the deflection curve. The deflection is found on the deflection scale to be about 1 per cent of the length of the span, which amounts to 6 ft. (1.8 m.). By continuing the vertical drop downward to the bottom of the chart the length of the wire is seen to be about 100.03 times the length of span.

The second use for which the charts were drawn is to find to what tension a stranded copper wire should be stretched and what sag it should have in order that it shall not be overstressed when subject to ½ in. (1.3 cm.)

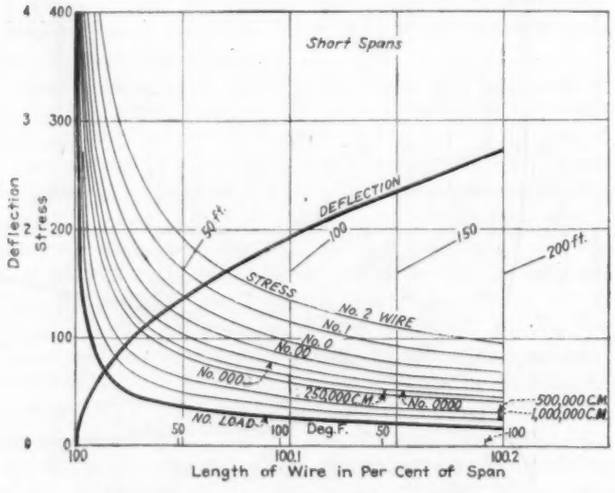
CORRECTIONS (IN PER CENT) FOR STRESS AT SUPPORT AND AT MIDDLE OF SPAN

Per Cent Sag	For Stress at Point of Support Add to Stress Curves	For Stress at Middle of Wire Subtract from Stress Curves
1	0.06	0.03
2	0.22	0.10
3	0.49	0.22
4	0.88	0.40
5	1.36	0.62
6	1.98	0.89
7	2.58	1.21
8	3.35	1.58
9	4.17	1.99
10	5.08	2.44

of ice and an 8-lb. wind pressure (39 kg. per sq.m.).

As an example let it be supposed that No. 000 wire is being strung on a 600-ft. (180-m.) span when there is no wind and the temperature is 100 deg. Fahr. What sag and tension must be given so that under conditions of ½-in. ice and 8-lb. wind pressure at 0 deg. Fahr. the stress shall not exceed 30,000 lb. per sq.in.? This is a stress of 50 per foot of span; therefore from "50" on the stress scale draw horizontal to the No. 000 wire curve.

Through the intersection draw a line parallel to the diagonal 600-ft. span line. To the intersection with the temperature scale add 100 deg. Fahr. along the temperature scale and draw another line parallel to the 600-ft. line to intersect with the "no ice and no wind



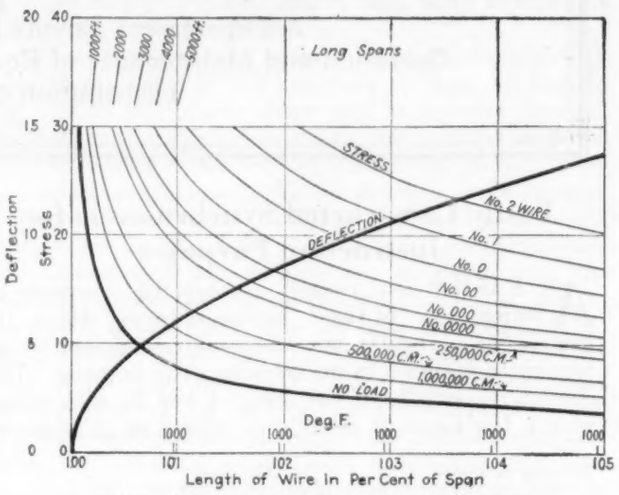
GIVES SAG AND TENSION FOR SHORT SPANS

curve." The intersection with this curve and the vertical to the deflection curve give:

Stress = 18.2 × 600 = 10,900 lb. per sq.in.
Sag = 2.65 per cent of 600 = 15.9 ft.

This stress is the average value. For the stress at the point of support and at the middle of the span the corrections shown in the table must be taken into account.

These curves are prepared for stranded copper wire of the following specifications: Modulus of elasticity, 16,000,000 lb. per square inch; temperature coefficient, 0.0000096; elastic limit, 30,000 lb. per square inch, and



SHOWS SAG AND TENSION FOR LONG SPANS

breaking strength, 50,000 lb. per square inch. Wind pressure, in pounds per square foot of projected area, is figured as 0.00252 × (actual velocity in miles per hour)².

Generator Used to Correct Power Factor After Engine Breakdown

SHIFTING of the reactive load between two generators in a Texas plant when one became inoperative made it possible for the other generator to operate more effectively and thereby continue satisfactory service. In this plant a small turbine and a 225-hp. Diesel engine operated in parallel, and owing to disabling of the engine from overheating of the cylinders the turbine was required to carry the load. To relieve it as far as possible from overheating, the generator of the Diesel engine was operated as a synchronous condenser by increasing the field excitation, thereby causing it to compensate for the lagging current required by the motor load. Decreasing the engine-driven generator field resistance did not increase the excitation sufficiently, and it was necessary to raise the exciter voltage and also cut resistance into the field of the turbo-generator. This maintained the station voltage at normal.

Under ordinary conditions it is better for the reactive current to be divided between the generating units as well as the actual load; but if one unit is more efficient than the other, the more efficient unit should carry the greater portion of the actual power and the less efficient unit the reactive current. One point to be remembered is that the copper loss is proportional to the resistance of the generator windings, and for minimum total losses these resistances should be known and the copper losses computed.

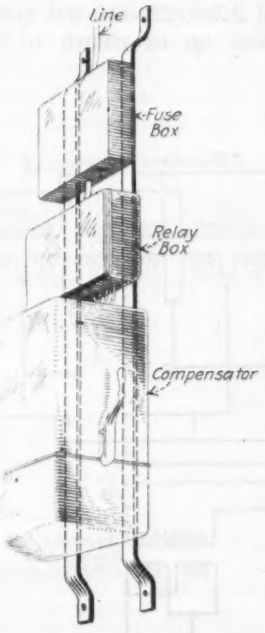
To shift the load from one generator to another the governor on the unit to have its load increased must be adjusted so that it will tend to operate at higher speed. To shift the reactive current from one generator to another, decrease the field resistance of the unit to be loaded until the line current of the other generator becomes a minimum.

W. A. DARTER.
Brenham Compress, Oil & Manufacturing Company,
Brenham, Tex.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Compensator Mounted on Strap-Iron Support



COMPENSATOR MOUNTED ON BRACKET AND WIRED TO FUSES IN SHOP

BY ASSEMBLING the starting compensator and fuse box on a strap-iron support before putting them up in the plant, the job of mounting or replacing such equipment is made quick and easy in the shops of McCleary, Wallin & Crouse, Amsterdam, N. Y. Furthermore, the various installations present a uniform appearance and tend to increase interest in maintenance. This strap-iron support is of 3-in. x 2-in. (7.5-cm. x 5-cm.) material and is about 5½ ft. (1.6 m.) long. It is drilled to take bolts for holding the equipment which is to be mounted upon it and also for fastening it to walls or pillars in the plant. The compensator, relay and fuse box are bolted to this strap and connections are made in the shop so that it takes very little time to set up the assembled outfit in the plant when it becomes necessary. The box for the fuses is made of No. 16 gage iron and measures 13 in. x 11 in. x 4 in. (33 cm. x 27.5 cm. x 10 cm.).

A. R. McDONALD.

McCleary, Wallin & Crouse,
Amsterdam, N. Y.

Contest Which Reduced Armature Repairs in Large Steel Mill

A CONTEST which pitted different operating sections against each other has been very effective in reducing the number of damaged armatures and the time lost in repairing motors in a large steel manufacturing mill. There are two prizes given to the sections of the mill which qualify. The first prize is given for the greatest relative improvement in reducing the number of changes of armatures necessitated by trouble in the electric motors. The second prize is for the greatest improvement in reducing the amount of time lost in different operations by reason of motor trouble. Honorable mention is given to four other sections, respectively for the best standing as regards armature changes, the best standing as regards lost time, the fewest armature changes in the present month and the least time lost in the month.

Although this plan is based on time lost, which may be evaluated, the general scheme might readily be referred to decreased output.

"Improvement" is based on the gain of the present standing over last month's standing and is expressed in percentage. What is called the "present standing" is based on a comparison of the last three months' operation with the last two years' operation. For instance, the standing as regards armature changes is expressed by equation (2). The top member of the equation expresses the number of armature changes per motor in use per ton of steel produced for the last two years. This is divided by the number of armatures replaced per motor in use per ton of steel produced for the last three months. The total is divided by 10,000 for convenience.

The section of the mill which has the highest value as derived by this equation is said to have the best standing as regards armature changes. The best standing as regards lost time is figured in the same manner. In calculating the "greatest improvement," for which the two prizes are given, the percentage gain in standing of the present month over the standing of last month is figured. The awards are made each month.

This system is well suited for a comparison of the carefulness of operators even in sections which have widely different equipment, functions and working conditions, as it takes into account the number of motors used in each section and the number of tons produced,

TABLE OF AWARDS IN CONTEST WHICH REDUCED NUMBER OF MOTOR TROUBLES

First Prize.—Greatest improvement in armature changes.
Second Prize.—Greatest improvement in time lost.
Honorable Mention.—(1) Best standing, armature changes; (2) best standing, lost time; (3) fewest armature changes in month; (4) least time lost in month.

$$\text{Improvement} = \frac{\text{Present standing} - \text{Former standing}}{\text{Former standing}} \times 100 \qquad (1)$$

Standing = Comparison of last three months with last two years
Armature changes:

$$\text{Standing} = \frac{A_3/M_3T_3}{A_2/M_2T_2} \times \frac{1}{10{,}000} \qquad (2)$$

A_3 = Number armatures changed in last three months.
A_2 = Number armatures changed in last two years.
M_3 = Number motors in use last three months.
M_2 = Number motors in use last two years.
T_3 = Tons produced last three months.
T_2 = Tons produced last two years.

Lost time:

$$\text{Standing} = \frac{t_3/M_3T_3}{t_2/M_2T_2} \times \frac{1}{10{,}000} \qquad (3)$$

t_3 = Number minutes' delay in last three months.
t_2 = Number minutes' delay in last two years.
Other letters are same as for armature changes above.

as well as the performance in the section for the last two years, which is indicative of the kind of service which the motors are performing.

Pittsburgh, Pa. D. W. BLAKESLEE.

Reconnecting a Two-Phase Motor for Three-Phase Operation

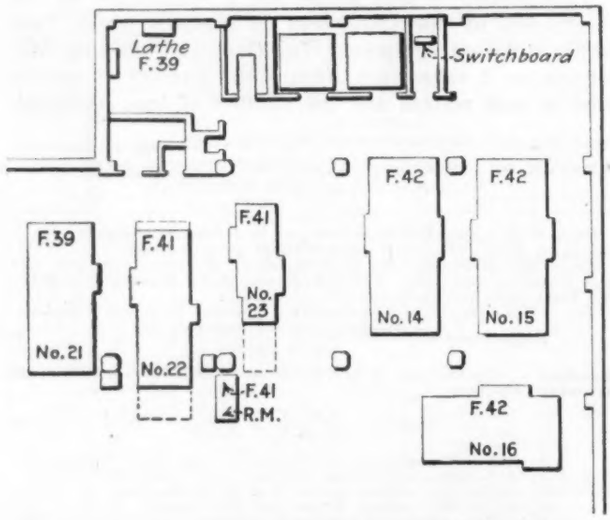
BY REWINDING a burned-out two-phase, 220-volt motor with twice the number of turns per coil but with wire of half the original cross-section the motor was prepared for easy reconnection to three-phase, 550-volt operation later. The motor was 5 hp., 60 cycles, 1,700 r.p.m., four poles, and had forty-eight slots and twenty-four coils, one coil per slot, connected as a basket-type winding. Each coil originally consisted of twenty-two turns of two No. 14 double-cotton-covered wires in parallel with the coils in series for 220 volts, two-phase. The pitch was 1 and 10.

As a two-phase motor has approximately 25 per cent more turns than a three-phase motor of the same voltage, and as 550 is 25 per cent more than 440, it follows that the windings of a 440-volt, two-phase motor are equivalent to a 550-volt, three-phase motor. This motor was therefore rewound for two-phase, 220-volt parallel operation, or two-phase, 440-volt series operation, by winding the coils with forty-four turns of No. 14 double-cotton-covered wire, which was twice the previous number of turns and half the conductor cross-section. The same coil pitch was used.

Bronx, New York City. C. A. JOHNSON.

Floor Map Near Board Helps to Replace Blown Fuses

TO LOCATE quickly which fuses on the distribution switchboard have blown, a floor plan showing the individual machines with numbers corresponding to numbers stamped opposite the fuses on the switchboard buses has been prepared in a New York printing



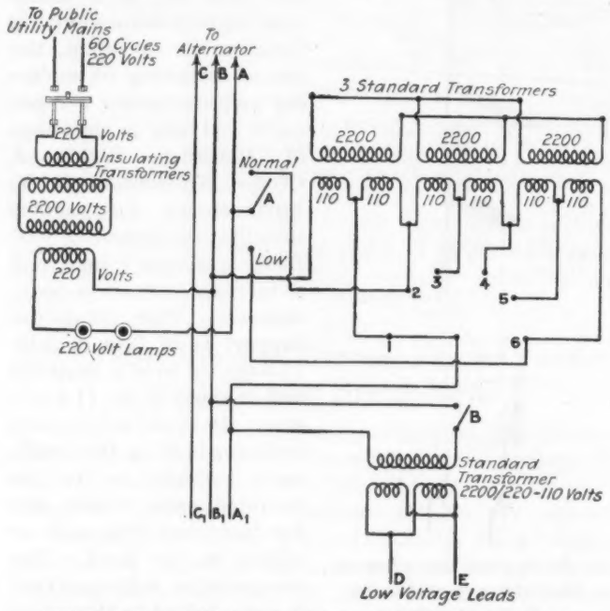
MACHINES IN THIS PLAN ARE NUMBERED CORRESPONDING TO NUMBERS OPPOSITE FUSES ON SWITCHBOARD

plant. These numbers are stamped opposite to each set of fuses on the copper busbars of the switchboard which controls each floor. Corresponding numbers are printed on the plan at each machine which is fed through the fuses. On the plan are also printed the numbers of the machines in the shop. Where a machine does not have a number the name of the machine is written on the plan, as, for instance, "lathe," shown in the upper left-hand corner of the drawing. This plan is framed and hung close by the switchboard. When the energy fails on any machine, by consulting the plan the fuses on the circuit feeding the machine may be removed and replaced by new ones. This saves the time of testing out the fuses to see which ones are blown.

New York, N. Y. W. A. HARRIS.

Various Single-Phase Voltages from Three-Phase Generator

TO OBTAIN various single-phase voltages from a 220-volt, three-phase alternator for testing, no auto-transformer being available, an industrial company in the East used three standard 2,200/220-110-volt transformers which were connected up as shown in the



SINGLE-PHASE VOLTAGES MAY BE OBTAINED FROM THIS COMBINATION AS WELL AS THREE-PHASE

diagram and so used as an auto-transformer, the primary of one transformer furnishing the exciting current for the two others. The 2,200-volt windings were connected in multiple and the 220-110-volt windings were all connected in series. Taps were brought out from each of the 110-volt windings to a sliding contact so that from one-half to three times the normal voltage of the alternator could be obtained across *A*1 and *B*1.

To use the alternator as a three-phase machine the sliding contact is placed at 2. To obtain the above results the switch *A* is placed in the up, or "normal," position. To secure very low voltage and high current switch *A* is thrown in the down or "low" position and the sliding contact placed at 1. By closing the switch *B* very low voltage and high current are obtained across *D* and *E*.

Another point of interest in this installation is the method of measuring the frequency. The frequency of the public utility company serving the district is kept at 60 cycles by means of a master clock so that it may be relied upon as accurate. By means of "synchronizing lamps" the speed of the test alternator can be adjusted till there is no flicker in the lamps, which shows that the alternator is operating at 60 cycles. The public utility 60-cycle, 220-volt lines were brought through a pair of 220/2,200-volt ½-kva. transformers, as shown.

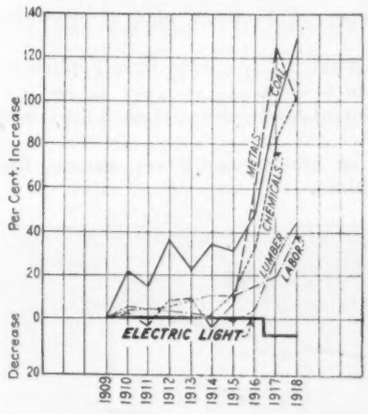
Ampere, N. J. EUSTACE C. SOARES.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

How the Electric Dollar Has Increased in Value

HOW the electric dollar grew is shown graphically in the accompanying chart prepared by the Philadelphia Electric Company for the information of its customers. To the general shrinkage in the purchasing power of the dollar this chart is a striking contrast. But maintaining the low price of electricity in spite of the advancing cost of all materials and services entering into its manufacture has been difficult. It has been possible only because of the tremendous demand for power permitting the use of large generating units having very high efficiency. The increased demand has brought a higher load factor, making fuller use of investment and reducing overhead charges per unit. Greater density of customers has helped more economical use of distribution lines and commercial services. How long these factors will keep the cost of electric service ahead of rising costs cannot be foretold, but it seems certain that electricity will never reach the high level of other commodities.



COMPARISON OF DOLLAR VALUE

Diagram showing how the electric dollar has increased in value while the dollar for many essentials has steadily decreased.

Credit Deposits and the Rate of Interest Thereon

BY KASSANDRA

IT IS said that some men have brains divided into two or more compartments with different sets of ideas in each compartment. So long as the ideas are kept separate the man appears sane, but if the compartments in his brain allow the different ideas to mix there is an explosion. The same thing would seem to be true of the different departments of some central-station companies, as when the president appears before a commission and explains that he has to pay 8 or 10 per cent to attract money, while at the office the treasurer is explaining that he cannot possibly afford to pay more than 3 per cent on the credit deposits.

It is not only the companies that are inconsistent. Recently there was an account of a company that had adopted the policy of returning deposits after the customer had established a good credit standing by paying his bills regularly for a year. In spite of the fact that this company paid 6 per cent on the deposits, it was reported that the customers were pleased to have them returned, but what did they do with their deposits? Probably when they got them back they went and put them in their checking account to draw 2 per cent. On the other hand, where did the company get the money with which to return the deposits? Probably it was borrowed from the bank at 7 per cent.

Of course, if each set of accounts is kept absolutely separate, there is an excuse, though a poor one, for the companies paying a lower rate of interest on the credit deposits than on bank loans or to its stockholders, just as a bank pays a lower rate of interest on checking accounts than on time deposits, but why should not the president and treasurer sit down together and look at it in a broad way?

It is true that any individual credit deposits can be withdrawn on short notice, but only if a customer discontinues service. We cannot imagine a run on the credit deposits like a run on a bank. The total amount of credit deposits stays pretty steady. Again the small credit deposits require more clerical labor than a large bank loan, but is not this clerical labor really part of the credit division of the new-business department rather than a cost of hiring money? Still further, would not the number of interviews required to arrange for credit deposits be much less and would not the customers have a much more cordial feeling toward the company if they were allowed as interest on their deposits the same rate that the company was allowed to earn on its stock or its investment, as for instance 8 per cent?

Such a policy would make customers not only willing but even desirous to make deposits and would reduce the labor of the credit division to a considerable extent. Even if the increased rate of interest on the present deposits made an appreciable increase in the costs, this would be more than balanced by the increased good will of the customers. If, still further, the making of deposits became so popular that the total amount increased, this would do no harm. No customer would have the right to make more than a reasonable deposit, and he could not withdraw it before he discontinued service, except at the option of the company. Then, if the credit deposits increased, this certainly should reduce the net working capital which the company would need, since only a small cash balance is needed to provide for the number of deposits which would be returned in any one day or week.

The clerical work could be obviated by using the idea of the war saving stamps (not transferable). A customer making a deposit would receive in his name a non-transferable certificate, for which he would pay $10 on Jan. 1 and $10.01 on Jan. 5, and so on until on Dec. 31 the amount would be $10.80, and all customers whose

accounts showed they held certificates would on Jan. 1 receive a credit of the interest. When they discontinued and their accounts were closed they would receive a check for the proper amount, the check saying that it was for the certificate less the bills due on discontinuance.

The important part, however, is not the clerical labor, but paying a rate of interest on deposits such that there shall be no excuse for complaint on the part of depositors. The result should be greater good will on the part of the customers of the company at an expense very slight in comparison to the results that would be obtained.

A Complete Plan for Merchandising Electrical Goods Properly

FOR years the electrical industry has talked of better merchandising and the education of the electrical dealer in this field. Much that was constructive has been accomplished. Education, bit by bit, has been making its impression. Now come the Westinghouse Electric & Manufacturing Company, Westinghouse Lamp Company and affiliated interests with an entire and tangible working plan for the proper merchandising of electrical appliances to the public. These interests have joined in the formation of the Westinghouse Merchandising Bureau, which is "primarily to make special studies of the problems of marketing electrical merchandising and to suggest plans which should result in securing the maximum benefits for all distributers of electrical merchandise."

In order to stimulate sales there has been developed a traveling merchandising exhibit, known as "Better Merchandising Shows." There are two shows, with the same properties but different treatment, one for the jobber and his salespeople and one for the electrical dealer.

The bureau aims to have duplicates made for each of the company's districts. The shows contain some twenty wall charts, showing merchandising methods and containing ideas and statistics, and model store windows, showing also good and bad lighting and display tables. With each show goes an extensive merchandising program.

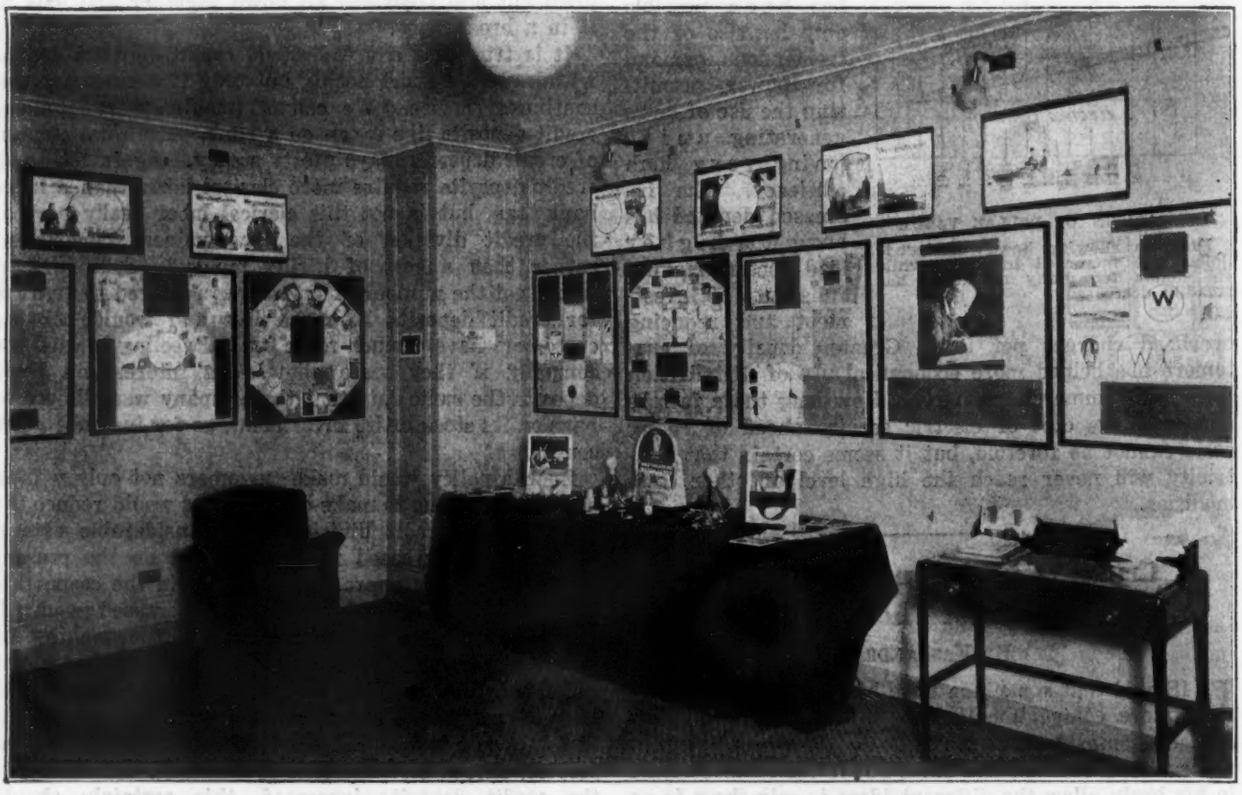
Before the dealers' show will be staged in any district the jobbers' show will be given, which will be attended by the jobber's salesmen, his merchandising manager, promotion men and the Westinghouse merchandising specialists who conduct the shows. The jobbers' show will cover two morning and two afternoon sessions of three hours each and one evening session of two hours on the same day, The program follows:

1. INTRODUCTORY.—Object of meetings, plan of meetings, scope of work.

2. MERCHANDISING.—What it is, to what lines applicable, why it must be done, how to do it.

3. ADVERTISING.—Different kinds, object of each kind, how the merchandiser uses it.

4. APPARATUS.—Talk on heating appliances, ranges, fan motors and sewing machines.



ONE CORNER OF THE "BETTER MERCHANDISING SHOW" WITH SOME TYPICAL POSTERS AND A TABLE DISPLAY

5. STOCKS AND SERVICE.—Volume and diversity, inventories and reports, stocks of dealers and contractors, use of lamp service record, repair part stock, service plan on heating apparatus and ranges.

6. VALUE OF A LAMP CONTRACT.

7. THE WESTINGHOUSE INDUSTRIES.

8. DEMONSTRATIONS.—Window illumination, window trimming, counter displays, shelf displays, demonstrations.

9. JOBBERS' FOLLOW UP "SHOW."—Getting new retail outlets, strengthening present dealers and contractors, how to run the "dealer show" and campaign, making permanent

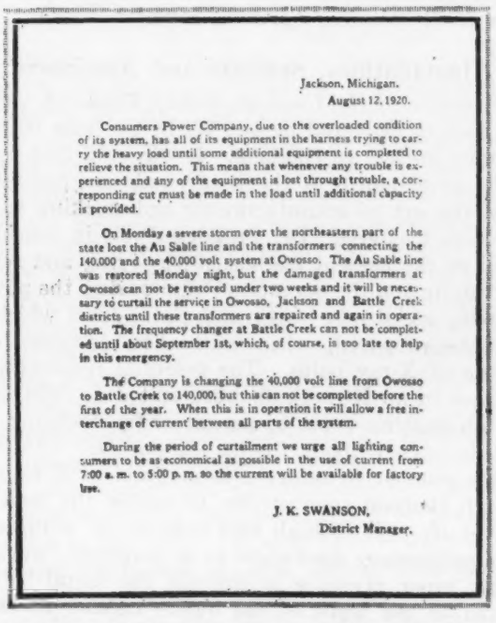
the "Better Merchant," exhibition of data showing past accomplishments.

Afterward the dealers' show will be ready for this territory, and will be given in each "dealer's center." This center will be chosen with respect to geographical location, train services, local buying tendencies, etc. In the East the centers will average about 50 miles apart and in the West about 100 miles. At these shows there will be in attendance the district office promotion men of the lamp and electric companies, the lamp and electric company salesmen and the agent jobbers' salesmen handling the customers who were invited to the show and the jobbers' merchandising manager. The program of this show is as follows:

1. OBJECT OF THE SHOW.
2. PLAN AND SCOPE OF WORK.
3. MERCHANDISING.
4. THE SHOW WINDOW.
5. THE COUNTER DISPLAY.
6. ARRANGEMENT OF APPLIANCES.
7. STORE DISPLAY OF RANGES.
8. STORE DISPLAY OF SEWING MACHINES.
9. STORE ARRANGEMENTS.
10. ARRANGEMENT AND SHOW OF MATERIAL ON SHELVES AND IN WALL SHOW CASES.
11. PUBLICATIONS AND BOOKS ON STORE MANAGEMENT.
12. STORE ACCOUNTING.
13. TIME PAYMENTS.
14. LOCAL ADVERTISING.
15. LOCAL CAMPAIGN.
16. MANUFACTURER'S ADVERTISING.
17. ADVERTISING HELPS SUPPLIED BY MANUFACTURERS.
18. THE WESTINGHOUSE COMPANIES.

How a Michigan Company Helps Customers to Understand System Troubles

THE Consumers' Power Company of Jackson, Mich., believes in letting its consumers know exactly what to expect from cases of system trouble. The advertisement reproduced illustrates the character of the publicity matter used in warning consumers what to expect in cases of severe trouble on the system.



Jackson, Michigan.
August 12, 1920.

Consumers Power Company, due to the overloaded condition of its system, has all of its equipment in the harness trying to carry the heavy load until some additional equipment is completed to relieve the situation. This means that whenever any trouble is experienced and any of the equipment is lost through trouble, a corresponding cut must be made in the load until additional capacity is provided.

On Monday a severe storm over the northeastern part of the state lost the Au Sable line and the transformers connecting the 140,000 and the 40,000 volt system at Owosso. The Au Sable line was restored Monday night, but the damaged transformers at Owosso can not be restored under two weeks and it will be necessary to curtail the service in Owosso, Jackson and Battle Creek districts until these transformers are repaired and again in operation. The frequency changer at Battle Creek can not be completed until about September 1st, which, of course, is too late to help in this emergency.

The Company is changing the 40,000 volt line from Owosso to Battle Creek to 140,000, but this can not be completed before the first of the year. When this is in operation it will allow a free interchange of current between all parts of the system.

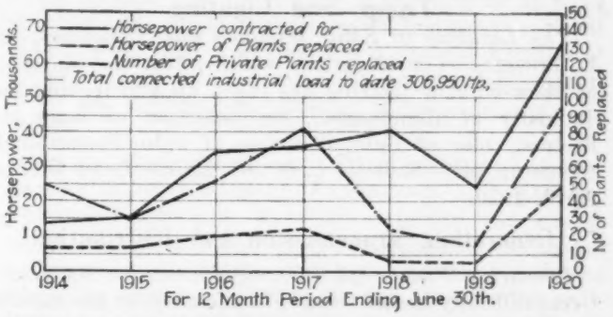
During the period of curtailment we urge all lighting consumers to be as economical as possible in the use of current from 7:00 a. m. to 5:00 p. m. so the current will be available for factory use.

J. K. SWANSON,
District Manager.

TELLING CONSUMERS WHAT SYSTEM TROUBLES MEAN HELPS THEM TO MAKE PLANS

Increased Use of Central-Station Power by Baltimore Industries

IT IS interesting to compare the new-business records of the Consolidated Gas, Electric Light & Power Company of Baltimore for the last seven years as graphically shown in the accompanying curves, giving the total horsepower contracted for, the horsepower and number of private plants replaced. As the curves represent the new business contracted for, a depression means simply a slower increase. The general shape of all three curves reflects two elements of Baltimore's industrial life—the acquisition of new manufacturing activities and the desire on the part of the manufacturers to bring production to a maximum through the most efficient method of operation. The period of uncertainty and cautious expansion during the early part of 1919 has been more than counterbalanced since June of that year through expansions, new industries and replacement of isolated plants. During the twelve months ended June 30, 1920, the Baltimore company took over 50 per cent more industrial power contracts than for any similar period in its history. Ninety-six plants, aggregating 24,667 hp. have been replaced since June, 1919. This brings the total connected industrial load on the company's lines to 306,950 hp.



THESE CURVES REPRESENT YEARLY ADDITIONS IN POWER FOR MANUFACTURING PURPOSES ONLY AND DO NOT INCLUDE DOMESTIC LOAD

Helping the Utilities Commission to Expedite Its Work

AT A MEETING of the executive committee of the Ohio Electric Light Association held subsequent to the recent convention of that body a discussion took place concerning the way in which the association could assist the Public Utilities Commission of the State in facilitating the early hearing of cases brought before it. A resolution was passed to the effect that the members of the association having business before the commission be requested to co-operate with that body and others interested in an effort to facilitate hearings and that they consent that such hearings may be had before one member of the commission, when a record of such hearing is made and will be available to the other members for their inspection and study, and that they do such other things as may be reasonably necessary to enable the commission to dispose of matters before it without unnecessary delay.

Co-operation with the commission was declared to be in the interest both of the utilities and the public, and the secretary of the association was instructed to bring the matter to the attention of the member companies.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Lamps and Lighting

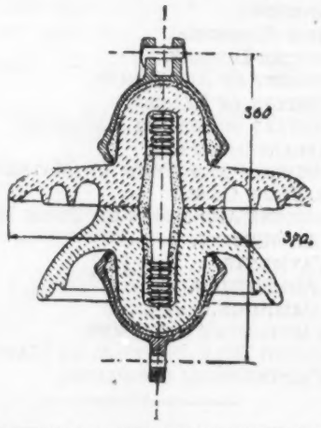
The Lighting of Show Windows and Showcases.—A L. POWELL.—Considerations which affect the planning of show-window lighting are taken up and include the intensity of illumination, the selection of lamp reflectors, color of light, direction of light, background, trimming, etc.—*Bulletin L. D. 103, Edison Lamp Works,* April, 1920.

Generation, Transmission and Distribution

Preparing Pittsburgh District Waters for Boilers.—Great difficulty is said to have been caused by the rapidly changing solution of several scale-forming substances with considerable free acid and undissolved organic matter in river waters of the Pittsburgh district. The Monongahela River water, for example, has changing characteristics which cannot be predicted. Water pumped from mines into the river is highly charged with sulphates, and the industrial pickling and by-product coke plants which line the river's banks for miles have a contaminating refuse water discharging at varying intervals and in varying quantities into the river. Acid waters from various plants dissolve the rocks of the river bed, thus increasing the scale-forming contents. The frequent testing and changing treatment required for this water are described.—*Power Plant Engineering,* Aug. 15, 1920.

Electrical Characteristics of Transmission Circuits.—XII.—WILIAM NESBIT.—In this number of the series the author takes up a comparison of various methods. The "localized capacitance" or "localized admittance" methods are discussed and a tabulation of the magnitude of the errors in the results as obtained by these approximate methods when applied to circuits of different lengths and frequencies is made. The graphical solution previously described in connection with the Wilkinson charts will be generally more accurate and shorter than these localized capacitance methods, it is said.—*Electric Journal,* August, 1920.

Characteristics and Tests of Suspension Insulators.—P. G. VENTURINI.—The conditions of working of porcelain high-tension suspension insulators are studied in detail in this article, and a new type of insulator devised by the author is described. The dimensions and form to be given to the different parts of the insulators in order to withstand without damage mechanical, thermal and electrical stresses and the tests to be made of such insulators are carefully discussed. The author considers that a good insulator to be employed for a line at the pressure V should present the following characteristics: Voltage of corona phenomenon, insulator dry, $2V$; voltage of the arc, insulator dry, $3V$; voltage of the arc, under rain, $1.5V$; voltage of perforation, in oil, $4.5V$. The new type of insulator devised by the author is shown in the figure. It is provided with double metallic cap, and the iron rod is embedded in cement and connects the two halves of the insulator. The iron rod consequently cannot assume a temperature different from that of the porcelain and cement and is therefore less liable to detach itself than in ordinary types, in which the iron, being in immediate contact with the air, immediately assumes its temperature.



NEW ITALIAN SUSPENSION INSULATOR

while the porcelain assumes it much later. The new insulator has a large capacity, which is useful when employing several of them in chain, in order to obtain a good distribution of the pressure along the chain.—*Science Abstracts, Section B,* July 30, 1920. (Abstracted from *Elettrotecnica,* April 15, 1920.)

Installations, Systems and Appliances

Evolution of the Coolidge X-Ray Tube.—A summary of a lecture delivered by Dr. W. D. Coolidge before the Röntgen Society in England. It was said that progress in the development of the X-ray bulb was possible only when the art of manufacturing and working tungsten had been mastered. Dr. Coolidge dwelt in considerable detail on the present method of purifying and reducing wolframite and the operations of sintering the powdered tungsten metal into blocks and plates from which disks could be prepared, when white hot, suitable for the targets of X-ray bulbs. The essential requirements of a target in an X-ray bulb were stated as follows: (1) A high melting point to permit sharp focusing of the cathode rays without fusing the target. (2) A high atomic number to secure a large yield of X-rays. (3) A high thermal conductivity to enable the heat to be got rid of. (4) A high heat capacity to withstand intense momentary discharges as in diagnostic work. (5) A low vapor pressure to prevent the metal being deposited on the walls of the bulb.—London *Electrician,* July 23, 1920.

Electron Power Tubes and Some of Their Applications.—WILLIAM C. WHITE.—In this article a substantial exposition is given of the factors of design and construction that determine the output of three-element

power tubes. A typical pliotron power tube is then taken up, and the properties of oscillating circuits for these tubes are discussed.—*General Electric Review*, June 1920.

The Selection of Oil Circuit Breakers.—W. A. COATES.—The writer discusses the rating of oil circuit breakers with reference to breaking capacity as defined by the British Engineering Standards Association. He also points out that there would be great advantage in having graphical methods of determining short-circuit current values in networks and shows a chart devised by himself which he says should be useful in this connection.—London *Electrician*, July 2, 1920.

Electrophysics and Magnetism

Fundamental Phenomena in Electron Tubes Having Tungsten Cathodes.—II.—IRVING LANGMUIR.—In the present and concluding installment the author treats of the fact that electrons impinging on solid surfaces frequently cause the emission of relatively large numbers of secondary electrons. He then tells how such phenomena may play a prominent part in the operation of vacuum tubes and describes striking experiments illustrating these effects. He also deals with the manner in which the various fundamental phenomena are co-ordinated to determine the operating characteristics of these electron tubes.—*General Electric Review*, July, 1920.

A New Galvano-Magnetic Effect.—LA ROSA and SELLERIO.—The resistance and thermo-electromotive force of certain metals change under the influence of a magnetic field. The authors have earlier investigated these magnetic effects and for their explanation advanced the hypothesis that the number of free electrons per unit volume is a function of the magnetic field strength. Working on the basis of this hypothesis, they further found that as a necessary consequence there must exist a longitudinal galvano-magnetic effect similar to the Hall effect, the latter, however, being of a tranversal nature. It now appears that experimental proofs have been given for the existence of such an effect. A short and wide cylinder of bismuth was placed coaxially between the pole pieces of a powerful electromagnet, and a current of 10 amp. was passed through the sample, between copper electrodes, along two diametrically opposite generatrices. At the center of each end surface of the cylinder electrodes were fixed, which were connected to a sensitive galvanometer. The magnetic lines of force, then, were parallel to the axis of the cylinder, and the two galvanometer contacts thus lay on the same magnetic line of force, while the current lines were perpendicular to the field. Upon reversal of the magnetic field a galvanometer deflection was observed which could not be fully accounted for by any known effect.—*Comptes Rendus*, June 14, 1920.

Electromagnetic Momentum.—H. A. WILSON.—The writer discusses fundamental relations involving electro-magnetic momentum, the relations of matter and ether to stresses and the transmission of energy and momentum in the field.—*Physical Review*, July, 1920.

Magnetic Properties of Iron Alloys.—The series of articles on the relation of magnetic properties and electric conductivity of iron to its percentage of carbon, aluminum, silicon and manganese, etc., published by Gumlish and Goerens in the *Elektrotochnische Zeitschrift*, June 26 to July 24, and referred to in these columns on Feb. 14, is reprinted almost in full in the *Revue Générale d'Electricité* of May 1, 1920.

Telegraphy, Telephony and Signals

Wireless Telephone Transmitter for Seaplanes.—The set described was designed primarily for the large flying boats of the United States Navy and has enabled transmission of speech over a distance of 150 miles (240 km.), it is said. The transmitter radiates at two wave lengths, 1,600 m. and 600 m. For the former wave length a trailing wire antenna of 0.0004 mfd. is employed, for the latter an emergency aerial of 0.00026 mfd. The transmitter is supplied with two three-electrode tubes of the pliotron type. One tube is employed as an oscillator for the production of radio-frequency currents and the other tube is employed as a modulator and as an amplifier of the voice currents that are communicated to it by the microphone.—London *Electrician*, July 30, 1920.

Adaptability of Aërial and Cabled Telephone Lines for Carrier Wave Multiplex.—FASSBENDER and HABANN.—Ordinary telephone lines are intended for use at rather low frequencies, of a few thousand cycles per second at most. In the new high-frequency multiplex telephony, where sometimes frequencies in the radio range are employed, phenomena of a somewhat different nature therefore come into play. The article gives a discussion of the transmission theory as applied to this particular problem. The ordinary theory cannot be directly applied, since at these high frequencies the so-called line constants vary appreciably with frequency. Some interesting tables are included showing the variation with frequency of the leakage per unit length of line and of the angle of loss of the dielectric. For 0.8-mm. paper-insulated cable the leakage was found to vary from 20 micromho/km. at 1.5×10^4 cycles to 3,390 micromho/km. at 30×10^4 cycles, corresponding to a variation in the angle of loss from 6×10^{-3} to 50×10^{-3}. Another table shows the difference between the wave length at given frequency in ether and when the wave is transmitted along a line. For the cable above the authors find that for a frequency corresponding to an ether-wave length of 7,000 m. the actual wave length is only 4,090, while at 1,000 m. the actual wave length is 716 m. On an aërial line of 4 mm. wire a 20,000-m. ether wave will set up waves of 19,490 m. length, and similarly an ether-wave length of 1,000 m. will correspond to a wave length of 975 m. along this aërial.—*Jahrbuch für drahtlose Tel. und Tel.*, May, 1920.

Miscellaneous

The German Incandescent Lamp Combination.—F. PINNER.—The Germans are getting together and preparing for industrial rehabilitation by combining interests so that internal competition will be avoided. The large aniline dye factories during the war pooled all interests and now are actually operated as one giant concern. Recently a similar combine was formed by the incandescent lamp manufacturers. The Auer company, controlling the "Osram" patents, and the A. E. G. and the Siemens-Halske, both licensees of certain General Electric Company patents, have discontinued their respective lamp departments and founded a new concern, the Osram-Werke G. m. b. H., which is taking over all incandescent-lamp business in Germany. The new company has a capital of only 10,000,000 marks, although the factories owned by the company represent physical properties which have a value of many hundred million marks.—*Teknish Tidskrift, Elektroteknik*, June 2, 1920.

WHILE GRANTING to the Potomac Electric Power Company an increase in rates, the Public Utilities Commission of the District of Columbia objected to the insertion of a coal clause on the grounds that there would then be no incentive to purchase coal advantageously.

HYDRO-ELECTRIC DEVELOPMENTS in eastern Iowa are contemplated in which twelve to fifteen small automatic plants eventually will be erected.

PLANS FOR SEATTLE'S Cedar Falls power house to develop an additional 20,000 hp. are now ready for approval, and as soon as this is secured the work will be rushed through.

THE SUPREME COURT OF CALIFORNIA has annulled an order of the State Railroad Commission requiring the city of Pasadena to file with it a schedule of rates.

B. E. MORROW, manager of the production and transmission department, and J. G. Hemstreet, superintendent of operation of the Consumers' Power Company of Jackson, Mich., are seriously investigating the possibility of using a slow speed aeroplane in combination with a system of wireless telegraphy in the patrol of its high-tension lines.

THE NEZ PERCE TELEPHONE COMPANY alleges that the Grangerville Electric Company has constructed 5 miles of electric lines parallel to the telephone company's line and in such proximity as to render the telephone company's lines worthless on account of inductive interference and has asked the commission to order the removal of the electric power line.

WORK OF CONSTRUCTING the Link River power dam, under order of the California-Oregon Power Company, has been ordered discontinued by the company, due, it is said, to the fact that construction of the dam would raise the level of Klamath Lake to flood 15,000 acres of land, which has been protested to the Interior Department.

HYDRO-ELECTRIC PLANTS on the Androscoggin and Kennebec Rivers have been interconnected by the Central Maine Power Company through the completion of a 45,000-volt tie line between the Augusta and Lewiston districts.

UTILITIES, in spite of priority orders, have been unable to obtain sufficient coal on their contracts and so are forced into the spot market, according to a prominent utility operator, although plenty of spot coal may be obtained in New York for a price.

FINAL PLANS are complete for the New England Geographic Division, N. E. L. A., convention at Kineo, Me., Sept. 13-17.

ELECTRIC RAILWAY LINES in northeastern Massachusetts are negotiating for the purchase of central-station energy, the existing scattered direct-current plants used in traction service having approached the limit of efficient expansion.

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

MICHIGAN HAS a coal committee which is making a study of the stocks of coal which utilities throughout the state have on hand.

A LIGHTING DEPARTMENT has been organized by the National Electric Light Association to teach, by means of demonstrations, manufacturers, merchants and the general public the most efficient use of electric light.

THE CARRYING OUT of the St. Lawrence River project, which would give a waterway direct from the Middle West to Europe, is offered as a solution of the nation's power and transportation problem by H. C. Gardner of Chicago in a survey which he has made for the American Society of Mechanical Engineers.

THE WESTERN SOCIETY OF ENGINEERS has gone on record as recommending the retention of the Public Utilities Commission, and instead of impairing the law which created it, urges the strengthening of that law.

STOCKS of electrical material are rapidly being built up under improving deliveries, with overstocking reported in instances.

COLLECTIONS are still far from being satisfactory, but improvements are seen in some sections.

IN ORDER to devote more time to technical matters the California Institute of Technology has eliminated modern languages from the required curricula.

AT THE Nebraska N. E. L. A. section meeting Mayor Smith of Omaha went on record as favoring valuation on present-day costs as a basis for rate making.

IN SPITE of a falling cotton market firm prices rule for loom because of the cotton purchased in advance to cover orders.

AN ACTIVE DEMAND for asbestos wire is reported, with factory stocks about cleaned out.

SAMUEL GOMPERS has urged Kansas labor unions to hold a conference to outline plans for a statewide campaign for the abolition of the Kansas Court of Industrial Relations.

AT ITS annual convention this week at Spokane the Northwest Electric Light & Power Association adopted the co-operative idea under the name of the Northwest Electric Service League.

THE COAL SITUATION of the Northwest is improving and if nothing is done to interfere with priority shipments to that section a sufficient supply will probably be received before winter conditions set in.

INCREASED RATES will restore confidence in public utility securities, it was pointed out on Wednesday by President W. R. Kenney at the annual convention of the Pennsylvania Electrical Association.

IN A REPORT to the North Carolina Chamber of Commerce, Thorndike Saville recommends, among other things, the passage of a water-power conservation bill retaining to the State authority over its water and forest resources.

A PLAN for the construction of a $20,000,000 reclamation and water-power dam in Boulder Canyon on the Colorado River with a capacity of 240,000,000 acre-ft. is being contemplated.

COMMERCIAL BODIES in the Northwest are much opposed to handling water-power permits for that region from San Francisco and are urging the establishment of a regional office of the Federal Power Commission in either Portland or Seattle.

THE FEDERAL POWER COMMISSION has completed its rules and regulations governing the application for and granting of water-power permits and licenses.

THE CONFERENCE CLUB is to meet at White Sulphur Springs, W. Va., Sept. 30, Oct. 1 and 2.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Federation Going Strong with Local Societies

SINCE last week the governing bodies of some six additional local technical and engineering societies have advised the Joint Conference Committee that they have made favorable recommendations to their respective organizations regarding the invitation to join the Federated American Engineering Societies. These societies have a combined membership of about 4,000, which, added to the 28,000 membership of the five societies which have already joined, makes a total of 32,000. A number of societies will give the matter consideration at the first fall meeting. The committee is very favorably impressed with the way the local societies are taking hold.

The Joint Conference Committee is expected to announce the date and place of the November meeting of the American Engineering Council together with the suggested program in about two weeks.

Regulations Governing Application for Water Power Permits Completed

THE rules and regulations governing the application for and granting of water power permits by the Federal Power Commission have just been completed. There are ten regulations as follows: (1) Definition of terms, (2) general requirements for applications, (3) applications for preliminary permits, (4) applications for licenses—major projects, (5) applications for licenses—minor projects, (6) applications for licenses—major projects already constructed, (7) declaration of intention, (8) priorities and preferences, (9) permits, (10) licenses. The first seven regulations deal more with routine detail, while the last three are of more general interest and consequently will be presented in full in next week's issue of the ELECTRICAL WORLD.

Northwest Men Want Regional Water Power Office

LIVELY bidding is going on among commercial bodies of the Pacific Coast for designation of their respective cities as regional or field offices of the Federal Water Power Commission, to receive applications on behalf of the commission, and perform other functions under the new water power law. The Seattle Chamber of Commerce has urged that Seattle be given the appointment, and urgently protests the tentative plan of locating the government offices in San Francisco to handle business for the Pacific Coast. It is urged that Seattle is the logical headquarters for Washington, Oregon and Idaho, which have 125, 68.4 and 60.4 horsepower per square mile respectively in contrast with 49.4 horsepower for the state of California, and no consideration is taken of the power possibilities of Alaska.

The city of Portland has also filed its claim with the commission, asserting that Portland is the center of the greatest potential hydro-electric energy of any known city in the world.

Western Society of Engineers for Retention of Illinois Commission

THE board of direction of the Western Society of Engineers has passed the following resolution:

"*Resolved*, That the board of direction approve the report of the public affairs committee and recommend to our members and to the public the retention of the Public Utilities Commission of Illinois, and instead of impairing the law which created it urge the strengthening of that law."

The results of poor service when rates are too low and extravagance and corruption when rates are too high met with under the old bargaining system that home rule brings about is pointed out in the report. That the old system is fundamentally unfair is asserted, since a third party is required to whom each side could present its arguments for an impartial decision. The committee believes the new system of state regulation and rates by a commission is the natural and logical outgrowth of the attempt to remedy the old and unbearable faults of the old system. The report of the committee deals principally with the controversy between the city of Chicago and the State Utilities Commission over the recent raise of street railway fares, in which the question of home rule is involved.

Northwest Division N. E. L. A. Indorses Co-operative Plan

THE Northwest Electric Light & Power Association, which is the Northwest Division of the N. E. L. A., adopted the co-operative campaign idea at the opening day's session of its annual convention at Spokane, Wash., on Sept. 8, 1920. The plan is similar to the California Co-operative Campaign and contemplates the formation of a permanent advisory committee. Funds are to be raised to put the Northwest Electric Service League in operation in Oregon and Washington. The other organizations in the Northwestern states will follow as the growth of business in those sections warrants.

President J. B. Fisken reported the labor and rate situation presented a more optimistic outlook. He pointed out, however, the need of special vigilance in meeting the tendency of municipalities and local authorities taking over utility commission functions. A number of subjects needing research work were laid out by the commercial committee, R. W. Clark, Puget Sound Power & Light Company, chairman, as follows: (1) Cost data on competitive and other service; (2) efficiency methods in all departments; (3) methods used in securing rate

increases; (4) elimination of gratuitous service; (5) educational campaigns; (6) customer ownership campaigns; (7) increase of demand; (8) policy on special transformers, and services; (9) demarkation between transmissions and distribution lines and fixing of voltage in rural districts; (10) rates; (11) classification of costs for more intelligent comparison.

Uniformity in accounts was urged by the accounting committee and the particular need of including those requirements peculiar to the West in forms which may be fixed for national use was discussed. The joint committee of engineers and accountants to discuss a uniform interpretation of accounting clauses by utility commissions may be appointed in view of the confusion now existing in the Northwest where some companies serve consumers in more than one state.

Franklin T. Griffith, president Portland Railway, Light & Power Company was elected president of the association for the coming year. The convention continued on Thursday and Friday, Sept. 9 and 10.

Coal Situation in Northwest Shows Signs of Improvement

THE coal situation in the northwest while not exactly reassuring shows signs of improvement. The receipts of coal at Lake Superior docks continues far below requirements and if no modification of the Interstate Commerce Commission's Service Order No. 10 (which provides for the shipment of coal to the northwest before the close of the lake season) is made, a sufficient supply will probably be received. Akron and Cleveland have petitioned for a modification of the order to enable them to obtain coal for lighting purposes. However, rather than modify the order the Interstate Commerce Commission advised a meeting of the Akron and Cleveland representatives with Daniel Willard of the railroad committee and President Wentz of the National Coal Association to arrange shipments of coal to those cities by some other plan. During August the Duluth-Superior docks handled 1,400,000 tons of bituminous coal as compared with 718,000 tons during July. The season's shipments on Sept. 1 were estimated to be more than 2,000,000 tons behind those of last year. Daily receipts at Duluth-Superior docks will have to average over 53,000 tons until Nov. 30 if last year's supply is to be equaled. During August the average was only 46,000 tons daily.

California Court Annuls Order on Municipality to File Rates

AS THE result of the application for certiorari to review an order of the Railroad Commission of the State of California requiring the city of Pasadena, a municipal corporation, to file a schedule of rates for electric service, the commission's order has recently been annulled by the Supreme Court of that State. The court found "no tenable ground upon which to base the conclusion that the rates charged by a municipality for its service in carrying on any public utility, either within its own limits or in outside territory, are under the control of the Railroad Commission."

The proceeding is an outcome of the order issued by the Railroad Commission of California on the city of Pasadena, which city supplies electric service also in the adjoining city of South Pasadena.

Conference Club to Meet at End of Month to Formulate Plans

THE Conference Club is to discuss and formulate plans for converting the club into a permanent conference at the meeting which is to be held at Greenbrier Inn, White Sulphur Springs, W. Va., Sept. 30, Oct. 1-2, 1920. Invitations are now being sent out to attend this meeting, which it is hoped will include a sufficient number of leading men as to make it representative of the several branches of the industry. No program has been laid out for the meeting.

Increased Rates Will Renew Confidence in Utility Securities

THE obvious part the central station is to play in improving the present disturbed economic condition is the providing of an adequate and dependable source of power supply for all needs, stated President W. R. Kenney at the thirteenth annual convention of the Pennsylvania Electrical Association, which opened at Bedford Springs, Pa., on Sept. 8.

"Lack of power and a tight money market," said Mr. Kenney, "have militated against effecting industrial improvements promptly. The essential factor for the time being is that of obtaining capital. The Interstate Commerce Commission has granted the railroads relief through increases in rates and thus renewed confidence in railroad securities. This is undoubtedly typical of the position of other utilities and they will produce an even more favorable showing regarding their values."

Colorado Association Convenes Next Week

NEXT week, Monday, Tuesday and Wednesday, there will be held at Glenwood Springs, Col., a combination convention of the Colorado Electric Light, Power & Railway Association and the Rocky Mountain Division of the National Electric Light Association, for which the following program was prepared:

MONDAY, SEPT. 13

Morning.—Welcoming address, C. W. Darrow, Mayor; address of the president, Norman Read, the Colorado Power Company, Denver. "The Present Financial Situation," by A. C. Foster, president Bankers' Trust Company, Denver; "Factors Controlling the Selection of Insulators," by L. C. Williams, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Afternoon.—"Present Day Trend of Utility Regulation," by G. E. Halderman, chairman Public Utilities Commission of Colorado; "Modern Illumination" (illustrated with lantern slides), by Otis L. Johnson, Illuminating Engineering Society.

TUESDAY, SEPT. 14

Morning.—"National Electric Light Association Activities," by Martin J. Insull, president N. E. L. A.; "Power Sales," by F. F. McCammon, Denver Gas & Electric Light Company, Denver; report of special committee on uniform power contracts, T. O. Kennedy, Denver Gas & Electric Light Company, Denver.

Afternoon.—"The American Plan," by E. A. West, Denver Tramway Company, Denver; "Central Station Merchandising Methods," by Thomas F. Kennedy, Western Light & Power Company, Boulder.

WEDNESDAY, SEPT. 15

Morning.—"Lighting Sales," by G. S. Merrill, National Lamp Works of General Electric Company, Cleveland, Ohio; "Public Policy," by J. F. Greenewalt, Mountain States Telephone & Telegraph Company, Denver.

Water Power League to Hold Convention Next Month

PRODUCERS of water power, users and prospective users of the same, state officials and others interested in the subject have been invited to attend the convention of the Water Power League of America, to be held in Washington, D. C., Oct. 7 and 8. The convention is called for the purpose of giving the representatives of the various states interested in this subject an opportunity to meet with the Federal Power Commission.

The Eastern super-power zone survey now under way will be discussed at the convention by William S. Murray, chief engineer of the survey. The federal water power act will be presented by O. C. Merrill, executive secretary of the Federal Power Commission. Related questions of drainage, forestation, etc., will be covered by state officials and others to whom these related questions mean almost as much as the development of hydro-electric power.

Such practical subjects as "Financing Under the Federal Power Act," "The Advantages of the Federal Power Act from the Standpoint of the Practical Developer and Operator" and "Co-operation Between the Power Producer and the Federal Power Commission" will also be presented. The farmers' side will be covered in "What the Farmer Expects from Water-Power Development" by a representative of the National Grange.

Michigan Governor Appoints Utility Men on Coal Committee

GOVERNOR ALBERT SLEEPER of Michigan has appointed a committee to handle the coal shortage situation now facing the domestic and industrial coal consumers of that state. Among those appointed are Charles B. Kelsey, utility engineer, Grand Rapids, Mich., and B. E. Morrow, manager of production and transportation of the Consumers' Power Company, Jackson, Mich. The committee is now engaged in securing a detailed report of the fuel stocks of the gas, electric and railway companies throughout the State. This report is to include full information as to contracts and orders for fuel as well as amount of coal being shipped at this time on orders and contracts. This information when compiled will enable the committee to take adequate steps to assist Michigan fuel users in securing coal in sufficient quantities to enable their continuing operations without interruptions.

Coal Clause Objected To as Offering No Incentive to Buy Advantageously

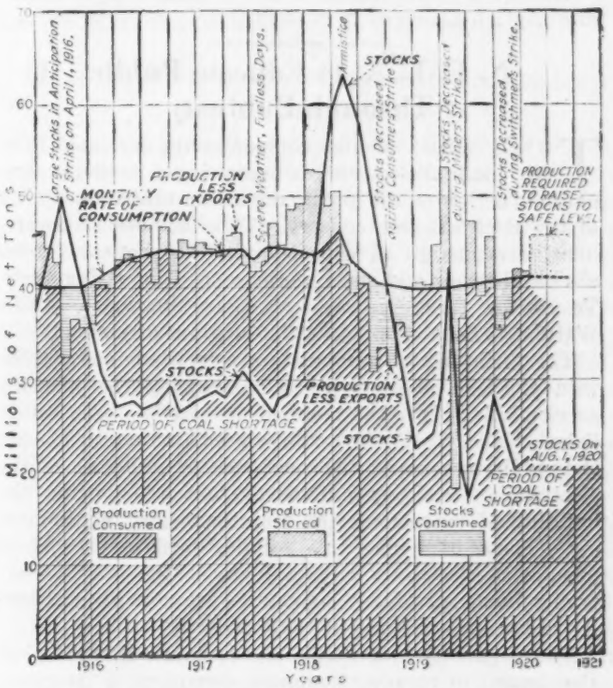
AN INCREASE of ½ cent per kilowatt-hour has been allowed the Potomac Electric Power Company by the Public Utilities Commission of the District of Columbia. The power company had asked 2 cents increase in the rate. In addition, certain concessions were made providing for increased pay for street lighting and the discontinuance of discounts. The ruling will increase the revenues of the company $400,000 yearly, the commission figures.

The increase was made necessary largely by the increase in the cost of coal. The power company had asked to insert a coal clause in its contracts with wholesale users of electricity. The commission objected to the coal clause, because "there is less incentive to secure coal at the most advantageous price when it is known that the cost is passed automatically to the consumer. As the increase in the cost of coal affects all consumers, such an increase should be borne as nearly as possible by each class in its proper proportion."

The Bituminous Coal Situation

THE accompanying diagrammatic representation of the existing bituminous-coal situation in the United States is reproduced from an article in *Coal Age* for Aug. 26 by C. E. Lesher, entitled "Is the Coal Shortage Real or Imaginary?"

The data from which this diagram was constructed were taken from official reports of the United States Geological Survey. The line of production less export is the monthly record of production of bituminous coal from which has been subtracted export less import.



COAL PRODUCTION, CONSUMPTION AND STORAGE FOR PAST FIVE YEARS

The result is production available for consumption or storage within the United States.

It will be noted that consumption increased nearly 10 per cent at the end of 1916 over the rate in the early part of that year, and that this rate of consumption was maintained until shortly before the armistice, when a sharp upward trend, culminating at the date of the armistice, took place. Immediately after the armistice consumption decreased, reaching its lowest level in several years in the months that followed. Its trend is now believed to be slightly upward. The small depression in the curve of consumption in the middle of the winter of 1917-1918 was due to the severe weather in those months and the extreme shortage of coal due to the inability of the railroads to make deliveries.

As the result of his investigation Mr. Lesher found that stocks are the lowest in five years, that the present rate of production is barely sufficient for consumption and exports, and that inequalities in production and distribution make necessary an output of 11,500,000 tons a week if a serious condition is to be forestalled this winter.

A. I. E. E. Meeting to Commemorate Ampere Centennial

THE hundredth anniversary of the important experiments of Ampere and his contemporaries will be commemorated at the October meeting of the American Institute of Electrical Engineers to be held at Philadelphia Oct. 8, 1920. Prof. Elihu Thomson and Prof. M. I. Pupin will address the meeting and demonstration will be made of some of the experiments originally performed by Ampère, Arago, Davy and Oersted. Other speakers are yet to be announced.

Two papers are to be presented at the afternoon session, as follows: "Economic Study of Secondary Distribution," by P. O. Reyneau and H. P. Seeyle, Detroit Edison Company, and "Electrical Demand Measurements," by P. A. Borden, Ontario Power Commission. Between the afternoon and evening session an informal subscription dinner is to be held.

N. E. L. A. to Educate Public Through Publicity

THROUGH its member companies the National Electric Light Association is beginning a publicity campaign to enlighten the public regarding the fundamentals of the electric light industry. This includes a comprehensive campaign of education in the commonly used electrical terms and some of the more interesting facts. To convey these messages a figure known as "Kilo Watt" has been adopted as the medium of contact.

The "Kilo Watt" pamphlets are written in a lighter vein and are so designed to accompany the monthly service bills. Once the point of contact has been established, "Kilo Watt" then will be used further to educate the public in some of the more specific problems of the electric light and power industry, such as financing, the building of extensions, the maintenance of equipment, etc. These pamphlets are not designed at present to popularize electricity nor to increase the use of electricity because so many companies are now giving service to the utmost limit of their capacity.

The department of publicity of the N. E. L. A. has also issued to member company executives a pamphlet designed to show the necessity for their participating actively in local civic and commercial activities and also their becoming acquainted with their local newspaper editors.

Other publicity plans are under way to bring to the attention of important groups the essential facts regarding the electric light and power industry.

Omaha Mayor Advocates Valuation on Present-Day Costs

THE need of public understanding of the problems confronting the utilities before City Councils can be expected to grant rate raises was the burden of the address of President Thomas H. Fritts of the Nebraska Section of the National Electric Light Association, which convened at the Hotel Fontenelle, Omaha, on Wednesday. The need of higher rates because of increased operating expense and the difficulty in financing utility requirements was also dealt with. Mayor Smith of Omaha in his address of welcome indicated his appreciation of the vital importance of the power company in the industrial life of the community and described the difficulty of finding a basis on which to determine rates. He stated as his belief that utilities are entitled to valuations of their property on present-day costs as a basis for rate making, though there is some difficulty in determining what these values are. He declared that it should be possible to settle them on a man-to-man business basis between the utilities and the city council without reference to political consideration.

Getting the facts of utility difficulties before the public in an understandable way, the importance of not underestimating depreciation and the need of better accounting methods were forcefully dealt with in J. A. C. Kennedy's discussion of the legal obligations of the central station.

Central station merchandising, in which the necessity of placing the business on its own foundation and making it stand alone, and a discussion of the rural distribution problem occupied the remainder of the Wednesday morning session. A luncheon at the Omaha Field Club, followed by sports, occupied Wednesday afternoon. The evening was devoted to the annual dinner and a discussion of public relations in Nebraska. The sessions closed Thursday after addresses by President Insull of the N. E. L. A. and the Hon. Thorne A. Browne of the Nebraska Railroad Commission and a disucussion of illuminating engineering and lighting development.

Electrical World Trade Service Increased

WITH the addition of weekly reports from St. Louis covering the Southwest, and from Salt Lake City and Denver covering the intermountain states the ELECTRICAL WORLD is now able to give a comprehensive picture each week of the electrical market conditions in each of the important trade centers. Besides the reports from the two newly added centers ELECTRICAL WORLD is regularly giving market reports from Boston for New England, New York for the Middle Atlantic States, Atlanta for the Southeast, Chicago for the Middle West, San Francisco for the Southern Pacific and Seattle-Portland for the Northwest.

Plan for a Large Irrigation and Power Project in Boulder Canyon Outlined

UPON his return from the League of the Southwest conference in Denver recently, Governor Bamberger of Utah told of a plan outlined by Arthur Powell Davis, director general of the United States Reclamation Service, which comprehends the building of a dam in Boulder Canyon to cost about $20,000,000 with a capacity of around 240,000,000 acre-ft. of water. It would take care of 10,000,000 acre-ft. of silt which is annually brought down the Colorado when the flood waters rush down.

Two areas of lands would come under the stored waters of Colorado tributaries in case this giant dam were built. On the South Myton bench 65,000 acres can be placed under irrigation with waters from the Duchesne basin, and 27 miles north from Green River 240,000 acres of adjacent lands would thereby be made fertile.

The storing of such immense quantities of water would develop considerable water power energy, that near Green River producing about 290,000 horsepower. This in a few years, according to Mr. Davis, would

become more important than the water impounded. It was estimated that the Colorado produces 2,666,000 hp., now unused.

The state engineer of Utah was much impressed with the plan as sketched at the Denver meeting, and said that the dam at the Boulder Canyon is a practical solution of the whole problem, as it would not waste valuable lands in impounding water upon them, and he was of the opinion that all the states concerned would back the plan strongly.

Coal Profiteering Charged by Prominent Utility Man

PLENTY of coal may be obtained in New York for immediate delivery providing the price is paid, a prominent electrical utility operator asserted to a representative of the ELECTRICAL WORLD this week. In spite of priority orders he stated utilities have been unable to obtain sufficient coal on their contracts, due to the shortage of cars, and so have been forced into the spot market.

"With contracts calling for coal at piers at a price of approximately $7 per ton," he said, "the spot market is $12 to $15. The difference is profiteering. Contracts are now being offered by large coal operators at prices ranging from $4 to $4.50 per ton at the mine, and as this figure leaves a reasonable profit, any charge over that represents undue profits and should be drastically curtailed. The apparent lethargy of government agencies who are charged with restricting profiteering; the low demurrage charges on coal cars which do not prevent speculative holding of coal in cars, and the serious plight of the railroads, are the fundamental reasons why the public utilities will either be forced to go into the winter without proper fuel storage or else pay double for coal which even now represents 65 per cent of the total operating expense."

N. E. L. A. to Conduct Lighting Demonstrations Through New Department

IN ORDER to promote the installation of lighting demonstrations for the purpose of educating the public, manufacturers, merchants and all others interested in illumination, the National Electric Light Association has instituted a lighting department. This department is not to engage in selling energy but is intended to teach the proper and most efficient use of illumination. The planning and carrying out of the work has been delegated to the lighting department, composed of the following committee: Charles L. Law, chairman; Oliver Hogue, G. Bertram Regar, W. A. Morton, Franklin Overbagh and Ward Harrison, industrial illumination expert, as field director.

An advisory executive committee has also been invited to serve as follows: Gen. George H. Harries, president-elect Illuminating Engineering Society, chairman; Frank W. Smith, vice-president N. E. L. A.; W. W. Freeman, president Society for Electrical Development; W. C. Peet, president National Association of Electrical Contractor-Dealers; F. S. Price, chairman lamp committee, Electrical Supply Jobbers' Association; M. S. Seelman, chairman of the N. E. L. A. commercial section; W. Rawson Collier, general sales manager Georgia Railway & Power Company; S. E. Doane, retiring president Illuminating Engineering Society.

It will be the purpose of the advisory executive committee to use its influence with various local central station companies, contractor-dealers and chambers of commerce to put on industrial illumination demonstrations in their respective cities. Expenses of these demonstrations are to be carried by the local companies, contractor-dealers and others interested, but will be under the auspices of the N. E. L. A.

The first industrial illumination demonstration to be made under the above arrangement will be in New York City. Similar demonstrations have been conducted recently in California by the California Electrical Co-operative Campaign and in Chicago by the Commonwealth Edison Company. Requests have also been received from Cincinnati and Boston for an installation of industrial illumination exhibits.

At this time Mr. Harrison is preparing an itinerary of prospective cities where these demonstrations could be held profitably. This itinerary will be submitted for approval by the committee at an early date.

Hydro-Electric Developments in Eastern Iowa Contemplated

THE development of 12,000 to 15,000 kw. of continuous power on the Cedar, Maquoketa and Wapsipinicon Rivers in eastern Iowa is contemplated by the Iowa Railway & Light Company and the Iowa Electric Company. S. C. Dows, manager of the Iowa Railway & Light Company, in commenting on the project in Iowa papers announced that sites at Shellsburg, the Palisades near Mount Vernon, Cedar Bluffs, Rochester and Cedar Valley on the Cedar and at Canton on the Maquoketa have been acquired and additional sites along the Wapsipinicon are to be acquired. Hydro plants are already in operation at Anamosa, Oxford Mills, Maquoketa and Cedar Rapids. When the project is completed there will probably be twelve to fifteen plants and the use of automatic and remote control equipment similar to that in use in the Cedar Rapids hydro plant will be resorted to in order to hold down operating costs. Central operating points to control groups of plants are contemplated. The two companies now operate transmission lines covering territory within a radius of 80 miles of Cedar Rapids. The new plants will all be tied into this system for use with existing steam and hydro-electric plants. Several years' time will be required to complete the work.

Plans Ready for City of Seattle's Cedar Falls Power House

THE completion by the city architect of Seattle, Wash., of plans and specifications for the new Cedar Falls power house, designed to accommodate the necessary machinery to develop 20,000 hp. additional power, marks the last step preparatory to beginning actual construction work of this unit, figured to cost $1,000,000. The new concrete and steel structure will adjoin the present power house below the falls and is to house a Pelton overhung turbine, driving a Westinghouse generator. Transformers will be used to step the voltage up to 60,000 volts for transmission. This is the first unit of large size to be installed under the new system designed by Superintendent J. D. Ross, by which the generating unit and the transformers are considered as an inseparable unit without intermediate switches and buses. This same system is to be used at the Lake Union steam plant.

Hogged Fuel Used to Save Coal in Albuquerque, N. M.

HOGGED fuel, which has always been burned in sawmills but never extensively in central stations, is to be substituted for coal in the plant of the Albuquerque (N. M.) Gas & Electric Company to reduce the cost of fuel. Wood refuse will be obtained from a near-by sawmill and "hogged" or ground up by the electric company at its plant. To use the hogged fuel two additional boilers and conveying apparatus will be installed at a cost of $50,000. Coal will still be burned where the supply of sawmill refuse is insufficient. The generating station in which this fuel will be burned is rated at 2,100 kva. and last year produced 3,800,000 kw.-hr., with a consumption of 11,000 tons of coal, the greater share of which will be saved by the changes. Arthur Prager is general manager of the company and C. H. Nichols, Federal Light & Traction Company, New York, is chief engineer.

Off-Peak Business to Be Most Sought For This Year

FOR the next year or two the majority of the central stations will be more interested in those classes of business which can be taken on without adding to peak loads than in any other class of sales, was the opinion expressed at the Sept. 2 meeting of the lighting sales bureau of the Commercial Section of the N. E. L. A. by Chairman O. R. Hogue. He felt that a large majority of central station companies would have an oversold condition on power during 1921. This being the case, he expressed the belief that such activities as those of M. Luckiesh on lighting effects in the home and those of W. D'A. Ryan on high intensity street lighting and those other activities on such things as sign lighting should be uppermost in the bureau's thoughts. Specifically, the problem of this year is selling something which will not increase the peak for the central stations.

The aims and scope of the lighting sales bureau were redefined at the meeting, in order to make them more specific, as follows:

1. To promote appreciation of the present and potential value of lighting to the electrical industry.
2. To collect, analyze and disseminate information concerning lighting practice.
3. To promote lighting sales.

Consumers' Power Company Securities Offered to Customers

SEVEN per cent cumulative preferred stock sales on either a cash or partial payment basis is a new plan that was put into operation Sept. 1 by the Consumers' Power Company of Jackson, Mich. The stock is offered on a cash basis at $95 per share and accrued dividends. The partial payment plan calls for $10 payment at time of purchase, $10 per month for seven months and $15 as a final payment. Interest at 7 per cent per annum on monthly installments will be credited the purchaser on the company books and dividends from the last dividend date prior to the final payment will be charged the purchaser and an adjustment made. Purchases under the partial payment plan are limited to twenty-five shares and the purchaser has the option of withdrawing all partial payments on ten days' notice at any time prior to the date of final payment for the stock. The company agrees to pay 3 per cent interest on the amounts paid in up to the date of notice of withdrawal. Payments may be made in full at any time.

Contract for Financing by State of Line Construction Upheld

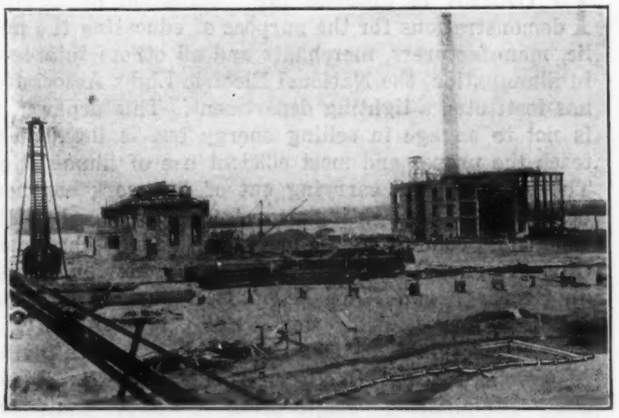
THE attorney-general of Utah has rendered a written opinion to the effect that the state of Utah should pay for the construction of a power line, built about a year ago, by the Dixie Power Company, running between St. George and Cedar City, Utah. The power company will use the line, and has agreed to purchase it from the state within three years.

The line was constructed under a contract signed July 8, 1919, between the State Road Commission and the Dixie Power Company. At that time the state contemplated the building of a hard surface pavement on that portion of the state road between Salt Lake and St. George, and it was asserted by the engineers that electric power, if it could be obtained, would be much cheaper than any other power for the operation of the necessary road machinery. The Dixie Power Company offered to furnish the power at the regular rates, provided the state would build the line, which would later be taken over by the power company.

The state auditor at the time opposed the signing of the contract with the power company, and now expresses the belief that the contract might really be the loan of the state's credit to the power company in violation of the provisions of the state constitution. The attorney-general holds that there is no such violation.

"It is one of the unfortunate things," says the attorney-general, referring to the fact that it is now pretty certain that the hard surface road will not be built there for at least some time, "but the obligation of the State Road Commission remains the same." He holds that the State Road Commission is both morally and legally bound to pay.

Pacific Power & Light's New Station



PROGRESS on the Pacific Power & Light Company's new gas and steam electric generating station on Youngs Bay, Astoria, Ore., is shown here. The steam building will be of reinforced concrete, 90 ft. x 111 ft. and 50 ft. high. Three Stirling water-tube boiler units of 600 hp. each, with superheaters and equipped for burning oil, will be installed, with space for the installation of Dutch ovens for burning sawmill refuse. A 3,750-kva., 11,420-volt, three-phase, 60-cycle General Electric turbo-generator is to be installed with provision for an additional 6,250-kva. unit. It is expected to have the plant in operation by Oct. 1.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Engineering Education Opportunities.—Under the title of "Opportunities for the Study of Engineering at American Higher Institutions," the bureau of education of the Department of the Interior has issued circular No. 20, listing the institutions of the United States where an engineering education can be obtained, showing the various departments at each institution and the enrolment.

Telephone Progress in Sweden.—A long-distance telephone of the latest American type, equipped with Pupin loading coils and telephone repeaters, has been ordered from the International Western Electric Company by the Swedish government for installation between Stockholm and Gothenburg, a distance of 310 miles. This cable is the first of a large number to be installed by the government of Sweden, which has long ranked among the foremost European countries as regards the number of telephones and prevalence of their use.

Electrification of German Railways.—The scarcity of coal has led to a well-developed movement in Germany for the electrification of the state railroads in conjunction with the development of water power. A correspondent of the Manchester (England) *Guardian* says in this connection: "The aim of the electrification of railways is to unite the south German water powers of Bavaria, Württemburg and Baden (Prussia has no water power worth mentioning) with the brown-coal (lignite) district in the center. The object of this is the establishment of a railway network, starting in the Rheinfalz and stretching through Baden, Württemburg, southern Bavaria, the Oberpfalz and Saxony, thence through Silesia, Brandenburg, Hanover and Essen, and finally uniting the Rhenish provinces, Westphalia and the seacoast. Everywhere water power and coal fields are being united, and they will start at Munich."

Augmenting Italian Output.—Two Italian companies operating hydroelectric plants on Lakes Santa Croce and Morto, in the Adriatic section, and now capable of producing 20,000 hp. and 8,000 hp., respectively, find this output so inadequate for their customers' requirements that, according to an American Consular report, they intend to increase their plant to a capacity of approximately 280,000 hp., with a possible output of 700,000,000 kw.-hr. a year. This would mean a saving of nearly 1,000,000 tons of coal.

Commercial Talk With Airplane by Radio.—Recently a member of a London shipping firm, using an ordinary telephone, succeeded in sending instructions to a representative in process of flight across the British Channel to France. The London business man spoke to the Croydon airdrome, and his message was switched through to the wireless installation of the government. Two calls from the desk brought an answer from the pilot in the air, after which the conversation with London proceeded with little difficulty.

"No Accident Week" a Big Success.—The week of June 6-12, which was observed as "no accident week" by a number of utilities in New York State and Pennsylvania (not including steam railroads), was marked by a great decrease in casualties, according to G. R. Rinke, secretary of the 1920 Safety Committee. Only one fatality, from electrocution, took place in the week named and none in the succeeding two weeks. During the corresponding three weeks of 1919 there were five fatalities. Figures compiled by the Utilities Mutual Insurance Company show a total of 8,268 days' lost time in "no accident" week," as compared with 22,896 for the preceding week this year and with 39,381 in the corresponding week last year. Moreover, the insurance company covers 45 per cent more employees this year than last.

Electrification of Swedish Railways.—The Swedish Parliament has appropriated 23,000,000 crowns (more than $6,000,000 at the old rate of exchange) for the work of electrifying the state railroad between Stockholm and Gothenburg. The work is to be completed by 1925.

Bogus Electrical Sunrise Fools the Birds.—Sunrise and breakfast being indissolubly connected in the bird mind, the managers of the London Zoological Gardens have found it possible to expedite the breakfast hour of their feathered charges, where this is desirable, by the simple expedient of turning on electric lights so arranged as to simulate dawn. The same method is said to be practiced by dealers in quail who wish to fatten their product for the market, and the assertion is made that by switching the electric light on and off a bird can be induced to eat every hour of the twenty-four, afterward going contentedly to roost in the "twilight."

The Montefiore Prize of Belgium.—Next year the triennial award of a prize of 20,000 francs for the best work written in the three preceding years upon the scientific advancement and technical adaptation of electricity will be made by a jury of ten electrical engineers, five Belgians and five of other nations, under the presidency of the director of the Montefiore Electrotechnical Institute of Belgium. This prize was instituted by George Montefiore, the late honorary president of the institute, and the coming award will be in reality that for 1917, when the war made the competition impossible. Works may be submitted in either French or English, in printed form or in typed manuscript. A dozen copies of each must be furnished, April 30, 1921, being the last day for their reception. The recording secretary of the Foundation, George Montefiore, may be addressed at 31 rue Saint-Gilles, Liége, Belgium.

Electrical Treatment Proposed for the Liberty Bell.—At a recent meeting of the American Welding Society a proposal is said to have been seriously made to subject the famous Liberty Bell in Independence Hall, Philadelphia, to electrical treatment to obliterate the crack and restore its original tone. The welder would work with a needle made of metal of the identical consistency of that of which the bell is composed, and particle by particle the fissure would be filled up. It has also been contended that by heating the bell electrically and then allowing it to cool slowly the metal "fatigue" which is said to threaten the preservation of the relic can be eliminated, so that the bell should ring out as clearly as in 1776.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Coming Meetings of Electrical and Other Technical Societies

Association of Edison Illuminating Companies—New London, Conn., Sept. 13-16. (For program see issue of Aug. 14, page 349.)

New England Geographic Division, N. E. L. A.—Kineo, Me., Sept. 14-16. (For program see issue of Aug. 14, page 350.)

Indiana Electric Light Association—French Lick, Ind., Sept. 15-17 (For program see issue of Aug. 28, page 442.)

Association of Iron and Steel Electrical Engineers—New York City, Sept. 20-24. (For program see issue of Aug. 7, page 300.)

Atlantic Division, Electrical Supply Jobbers' Association — Philadelphia, Pa., Sept. 23.

Central Division Electrical Jobbers' Association—Chicago, Sept. 24.

American Electrochemical Society—Cleveland, Sept. 30-Oct. 2.

Illuminating Engineering Society — Cleveland, Oct. 4-7. (For program see issue of Aug. 14, page 349.)

National Association of Electrical Contractors and Dealers—Baltimore, Oct. 4-9. (For program see issue of July 24, page 205.)

Electric Furnace Association — Columbus, Ohio, Oct. 6.

American Electric Railway Association—Atlantic City, N. J., Oct. 11-15.

National Association of Electrical Inspectors—Philadelphia, Pa., Oct. 12-13.

British Columbia Association of Electrical Contractors and Dealers—Vancouver, B. C., Oct. 19.

International Association of Municipal Electricians—New Orleans, Oct. 19-22.

Association of Railway Electrical Engineers—Chicago, Oct. 28-31.

Electric Power Club—Hot Springs, Va., Nov. 15-18.

Southeastern Geographic Division, N. E. L. A.—Miami, Fla., Nov. 17-19.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Courts Must Decide if Contract Is Violated by Shutdown.—Permission was granted the Chatham Electric Light, Heat & Power Company by the Public Service Commission of the Second District of New York to shut off current for three days from 7 a.m. to 4 p.m. from the line supplying the States Metals Company for the purpose of increasing the line insulation in order to increase the voltage, giving the manufacturer twenty-four hours' notice before shutting off the current. The States Metals Company claimed it was entitled to damages for shutting off the current, but this question, the commission held, is for the courts to determine. The commission held that it should confine itself solely to the public interests and that it is for the courts to determine whether any contract rights have been violated and if so to name the penalty.

Reparation for Charges Under Superseded Tariff.—By a former order the Public Service Commission of Pennsylvania canceled the tariff schedule of the Home Electric Light & Steam Heating Company and ordered a new tariff to be filed. It was found, however, that the electric utility was not receiving more revenue than it was entitled to, but that the rates were not equitably distributed among its customers. The Borough of Tyrone, however, claimed that its citizens should receive reparation for bills rendered under the tariff ordered canceled to the extent of the difference between the new rate and the old. The commission held, however, that the new rate could not be canceled until the later revision ordered by the commission had been filed, consequently the only tariff under which the company could charge was the one ordered canceled. Furthermore, since it was shown that the old rate yielded insufficient revenue the commission held that the company very properly refused to conduct its business on an unprofitable basis. The claim for reparation was consequently dismissed.

Commission Will Not Revoke Order Restoring Old Rates Because Certain Tariffs Are Missing.—Because its old rate schedule contained no municipal lighting tariff, the Susquehanna County Light & Power Company petitioned a modification of the order of the Pennsylvania Public Service Commission ordering the re-establishment of the old rates because it had failed to show the reasonableness of the increased rates. The commission stated that while it saw no reason to revoke or modify its order, still the company would be permitted to file any necessary new tariffs covering any particular rates and that the commission would permit the filing of such tariffs to become effective upon one day's notice to the public.

Rates to Meet Increased Costs.—The City Gas Company applied to the New Jersey Board of Public Utility Commission for increased gas rates not to yield a better return on the investment, but in order to meet increased operating costs. For this reason the commission did not consider the question of a return on the value of the property but undertook to determine what is a fair price to be charged for gas during the coming year, taking into account solely the increased expenses over those of the preceding year.

Stand-By Charge in Reclamation Service in California.—In connection with the schedule of rates for electricity sold to reclamation districts, an order was issued on Aug. 30 by the Railroad Commission of the State of California designed to cover variable conditions resultant from the use of energy by the different districts. Its effect will be to place all districts on an equal footing so far as rates are concerned, according to the commission, and to require them to pay a stand-by charge. The commission holds that reclamation service is primarily an insurance service, the average consumption per horsepower per year being very low.

Other Consumers Should Not Be Burdened with Cost of Special Service.—The Mountain Power Company in its application for increased rates for water service showed that on application it had installed for fire hydrant service larger mains than were necessary to deliver an adequate supply to its other customers. The California Railroad Commission stated that if any customer desires special facilities for the delivery of water, such as pipes of sufficient size so that a comparatively large quantity of water can be concentrated at one point at any time, that consumer must expect to pay the cost of rendering the service. It would be manifestly unfair, the commission held, to the other consumers of the company to burden them with the expenditure made for service such as is asked for by the municipality.

Increase Allowed, Bringing Rates Up to Those Charged in Surrounding Territory by Large Companies.—The Bay Point Light & Power Company was given an increase in rates for electric service approximating 25 per cent by the California Railroad Commission on Aug. 24. In its application for an increase in rates the company requested the commission to allow it to charge the same rates that the Great Western Power Company, from which it purchases energy, and the Pacific Gas & Electric Company charge in adjacent territory. The order of the commission brings the regular rates up to those charged by the larger companies besides adding a surcharge of 15 per cent.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Conclusiveness of Commission Orders.—The reasonableness of a rate established by the commission is the only justiciable question upon an appeal to the Oregon Supreme Court from a rate-fixing order of the commission, according to the finding of that court in Hammond Lumber Company vs. Public Service Commission, and the court will not assume the place of the commission or set its order aside on the court's conception of its wisdom. (189 Pac. 639.)

Establishment of Municipal Plants in Arkansas.—A question affecting city ownership of electric plants in Arkansas has been settled by the Supreme Court of that State in Walton vs. Commissioners of Light, Improvement District No. 1, City of Benton. This "improvement district" had been organized under the Arkansas statutes to purchase an electric light plant from a company which had allowed its franchise to be forfeited. To establish it a petition signed by a "majority in value" of property owners was necessary, and this the court declared had not been obtained, the value of railroad property not having been taken into account and officials of certain companies having signed the petition without proper authorization from boards of directors. (222 N. W. 1056.)

Electric Company Responsible for Line Over Which It Transmits Energy, Regardless of Ownership.—Finding, in Coleman vs. Iowa Railway, Light and Power Company, that the trial court was in error in directing a verdict for the defendant in a suit for damages because of the death from electric shock of the owner of a private line connected with the high-tension lines of the defendant, the plaintiff having erroneously charged that the company owned the subsidiary lines, the Supreme Court of Iowa held that this wrongful assertion did not invalidate the suit. The electric company, having contracted to supply the deceased with energy and having itself constructed the private line, was responsible for its safety, and it was the company's duty to insure that the low-tension wires did not come into direct contact with the high-voltage conductors through becoming loose. The contact between the high-tension wires and low-voltage conductors did occur, however, and this condition was found responsible for the fatal accident. (178 N. W. 364.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Herbert A. Barre has recently been given the title of executive engineer with the Southern California Edison Company, Los Angeles, Cal., a position which corresponds with the character of responsibility which has rested upon him for some time. Mr. Barre is a Canadian, having been born in Nova Scotia in 1875. He moved to California when a child and was educated in the schools of San Francisco, graduating from the University of California in 1897, in the College of Electrical Engineering. After a short period of miscellaneous technical work in that locality he spent a short time in the operating department of the old Edison Electric Company and with the Los Angeles Railway in southern California. Following this he was assistant in electrical engineering with the Oakland (Cal.)

H. A. BARRE

Traction Company, and later was associated with Thomas Mirk in the construction of Station A for the Independent Electric Light & Power Company of San Francisco. In 1902 he became assistant to the consulting engineer for the Huntington properties in Los Angeles: the Los Angeles Railway, the Pacific Electric Railway and the San Joaquin Light & Power Company; during that period a number of the hydro-electric and steam plants and transmission lines of those companies were constructed. In 1906 Mr. Barre became associated with the Electric Bond & Share Company, New York, as engineer, gaining varied experiences in engineering, evaluation, and operation of many Eastern and Southeastern electric properties. In 1907 he built the Glenwood and the Bowlder plants for the Denver Gas & Electric Company. Shortly afterward he joined in the formation of the Electric Construction Company, which built the Fossil Creek power station for the Arizona Power Company. In 1911 he took a position with the Pacific Light & Power Company of Los Angeles, as electrical and mechanical engineer, retaining until recently this title with the Southern California Edison Company following the consolidation of the two companies in 1917. After his association with the Pacific Light & Power Company the famous Big Creek plants and 150,000-volt lines of that company were constructed. For several years Mr. Barre has been very active in affairs of the American Institute of Electrical Engineers and the National Electric Light Association. He is at this time first vice-chairman of the hydro-electric and technical committee of the National Electric Light Association.

H. P. Liversidge, assistant chief engineer of the Philadelphia (Pa.) Electric Company, has been appointed chairman of the power stations committee of the American Institute of Electrical Engineers. Mr. Liversidge succeeds Philip Torchio.

Graham Bright has been appointed chairman of the mine committee of the American Institute of Electrical Engineers, succeeding W. A. Chandler. Mr. Bright has for a number of years been engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Philip Torchio has just received the appointment of chairman of the technical committee on economics of electric service of the American Institute of Electrical Engineers, succeeding C. S. Ruffner. Mr. Torchio has been electrical engineer of the New York Edison Company since 1895, and has been closely identified with the development of the extensive alternating-current system of the New York Edison Company. He is a member of many engineering societies and has presented before their meetings papers and discussions covering a wide range of electrical engineering subjects.

W. D. Alderson of St. Louis, who has been appointed director of industrial relations for the Union Electric Light & Power Company of that city, is the junior past-president of the company's Employment Managers' Association of the St. Louis industrial district. For some years he had charge of long-distance line construction for one of the Bell telephone companies, and for the last eleven years he has been with the Union Electric Light & Power Company and its subsidiaries as estimator, superintendent of construction and employment manager. Born in St. Louis in 1881, Mr. Alderson, after graduation from high school, completed a correspondence course in electrical engineering, took the employment managers' course at Washington University last year and is now devoting his spare time to study of law at the same institution.

C. S. McDowell, who was elected as one of the vice-presidents of the A. I. E. E. for 1920-1921 and took office on Aug. 1, was born in Millersburg, Ohio, in 1884, and graduated from the U. S. Naval Academy in 1904. From 1912 to 1915 he was in charge of the Navy's electrical laboratories at the New York Navy Yard and from 1915 to 1917 electrical officer of the U. S. submarine forces. For one year following he was secretary of the Navy Department's board on anti-submarine devices and in charge of naval experimental station, New London, Conn. During the latter part of the war Mr. McDowell was on the staff of Admiral Sims in connection with anti-submarine warfare. At present he is on duty at the General Electric Company, Schenectady, N. Y., as naval inspector of ma-

C. S. M'DOWELL

chinery and inspector of engineering material. Mr. McDowell was commissioned a commander of the U. S. Navy in 1918. He has been interested in A. I. E. E. matters for a number of years and was instrumental in forming the marine committee of the A. I. E. E., of which he was chairman from 1913 to 1916.

L. T. Robinson, who has been connected with the General Electric Company, Schenectady, N. Y., since 1904, in charge of their standardizing laboratories, has been appointed chairman of the board's committee on technical activities of the American Institute of Electrical Engineers. Mr. Robinson succeeds Wilfred Sykes.

W. R. Bell has resigned as commercial agent of the Baton Rouge (La.) Electric Company, to accept a similar position with the Haverhill (Mass.) Gas Light Company. Mr. Bell has been connected with the Baton Rouge Electric Company since November, 1913, and has served as commercial agent since September, 1917. He will be succeeded by J. C. Lamb of the commercial department of the Tampa (Fla.) Electric Company. All three of these companies are under the management of Stone & Webster, Inc.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Prices for Loom Firm Despite Falling Cotton Market

CONTINUED firm prices, slight building up of stocks and some decrease in demand mark the non-metallic flexible conduit situation. No immediate price reductions are to be expected, according to manufacturers, notwithstanding the recent declines in the cotton market. These makers claim that they were obliged to buy cotton in advance in order to cover themselves on the large volume of orders which they accepted last spring. As a consequence loom is priced according to the spring price of cottom. In the New York markets current quotations are about $32.50 and $35 for $\frac{7}{32}$-in. and $\frac{1}{4}$-in. loom respectively.

Stocks are beginning to build up and some jobbers and manufacturers can ship immediately. Other manufacturers say that they have orders on hand for the next three months' production. Deliveries have been hampered by railroad trouble, but this trouble is diminishing. Labor conditions are satisfactory and production is reported to be normal.

As a general condition demand is falling to some extent, though it is still fairly strong. Collections are on the whole very good.

Increasing Supply of Friction Tape

FRICTION tape is being produced at a rate which is rapidly overcoming back orders, according to leading manufacturers. Cotton insulating tape on the other hand is in great demand, and production is falling behind orders. A leading maker of friction tape recently informed the ELECTRICAL WORLD that all production records were broken in his plant in a recent week, a total of 200,950 lb. being turned out. Tape manufacturers state that the raw material supply is now very satisfactory. Transportation conditions are improving, and a slackening of demand compared with a few weeks ago is facilitating the filling of back orders. Stocks are spotty, some makers having little tape on hand and others being prepared to make almost immediate shipment through agencies. Recent moderate reductions in the price of cotton have been insufficient to affect the price of friction tape to any extent. The latter quotes in representative cases from 60 to 70 cents per pound, according to quantity and quality involved. A representative jobbers' price last week on $\frac{3}{4}$-in. black friction tape was 68 cents per pound on lots of less than 10 lb., 60 cents on 10 to 25-lb. lots and 57 cents on 25 to 100-lb. lots.

One prominent distributer has sold four times as much tape to date this year as last for the same period, and still can make immediate deliveries on fairly good-sized orders. Another producer reports 80 per cent more business this year, the month of July showing the largest production in the company's history. Foreign business is running about 15 per cent ahead of last year this manufacturer states. Deliveries can easily be made in two to three weeks in large quantities. Labor conditions are steady for the time being, and since the wage increase accorded about three months ago production has been coming along well. Black and gray tapes are being sponsored vigorously by some manufacturers at present for use instead of white friction tape.

High-quality woven tapes used in the insulation of electrical machinery coils are in great demand. Deliveries are being quoted on about three months' basis. Prices are firm, with extremely wide range according to weave, size and quality purchased. A representative tape of high-class finish used in field coil winding sells for about $3.50 per gross yard, and a good quality used in armature coil work runs around $2. The cost of labor is a primary factor in price advances that have been made in the past, as well as in the increases in the price of the high-grade cotton involved in manufacture. No less than four handlings are required in preparing the raw yarn for weaving in one of the leading makes, and after the weaving the finishing process or calendering to exact size calls for skilled work. The thinner tapes must be finished with extreme accuracy on account of the space limitations of slots. It is not feasible to predict future price movements, but so long as raw material and labor costs remain close to present levels it is hard to see any early downward movement. Factory stocks are practically cleaned out and orders are holding up well.

Active Demand for Asbestos Wire

LONG deliveries, nominal stocks and firm prices characterize the market for asbestos-insulated wire. Leading manufacturers are very busy trying to fill back orders, and factory stocks are practically cleaned out. The supply of asbestos is reported ample, but the smaller sizes of copper wire are not obtainable in the desired quantities, chiefly as a result of recent prolonged strikes in the wire mills. Interruptions to copper wire production lasting about six weeks in one case and about twelve weeks in another cost the purchaser dear as well as the wire drawer. With increasing production in the wire mills following the return of steadier labor conditions the outlook is much improved for the smaller sizes of wire.

Deliveries quoted by representative manufacturers of asbestos wire on heater cord were six to eight months, fixture wire, eight to ten weeks, on moving-picture cable, ten weeks, and on magnet wire, eight to twelve weeks. If the leading producers did not take another order before 1921 there would be little trouble in keeping the plants running. One manufacturer who had about fifty-six weeks' work on hand last June 1 now has orders enough on his books to keep his employees busy until about July 1 of next year, barring cancellations. A few of these have been received, but no general disposition to retrench is evident. The demand for domestic labor-saving appliances is too large to permit any marked curtailment in the production of heater and stove wire at present. Just now all makers of asbestos wire are not pushing sales at the normal rate, but more effort is being placed upon production and plans for the enlargement of manufacturing facilities than upon getting new business. This is of course not equally true of all competing houses, but until production begins to overtake demand, less "missionary work" will be seen in the trade. Users of asbestos-insulated wire for railway motor service would do well to order their anticipated winter requirements within the next few weeks, and it is generally held in manufacturing circles that the recent firm and steady price levels will be held for some time to come. Labor conditions are showing some improvement, and since the recent advance of wages registered last spring no great difficulty has been encountered in obtaining enough employees for this class of material.

Representative factory prices of asbestos-insulated magnet wire start from 45 cents base on lots of 200 pounds or over, from No. 0000 to No. 4 B & S gauge, inclusive, and

extras are added per pound for the finer sizes ranging from 1 cent per pound on No. 5 to $3.85 per pound on No. 28. A 250-pound order of No. 18 would be quoted in a typical case at 72 cents per pound. Lots less than 200 lb. carry 2 cents per pound additional. A leading Boston jobber quotes $10 per 100 ft. on No. 18 black heater cord in lots of under 250 ft., and $8 for orders exceeding 250 ft. No. 18 fixture wire is selling for about $7.86 net per hundred feet, with a reduction to $7.20 on $50 orders. The outlook is good for increased facilities for production of asbestos wire during the next year or two, and with improved labor conditions and good supplies of asbestos and wire, record outputs may be expected from manufacturers.

Germany Hopes to Regain World Electrical Trade

WITH production costs high in Germany and her electrical industry almost crippled by the war, American manufacturers now supply most of the electrical goods formerly made by Germany, whose output before the war amounted to 40 per cent of the world's production, according to Herr Henrich, manager of the Siemens-Schuckert works. However, the Germans are endeavoring to regain this trade, particularly in such lines as cables, small motors and incandescent lamps. On the latter item alone they had plants to make 70,000,000 lamps a year, exporting formerly 50 per cent of this number but now less than 25 per cent. The *Berliner Tageblatt* reports an address delivered to the members of the Workers' Association of the German Electrical Engineering Industry by Herr Henrich, in which he said:

"In 1913 the German electrical industry occupied a prominent position both within our own borders and in the world, and it was responsible for 40 per cent of the world's production. Today the world position of the industry is deeply shaken, on account of the foreign, and particularly the American, competition which has sprung up in the interval, and all the more so as our inland production prices, in the present state of exchange, are already above the market prices of the world, with the result that we are no longer capable of competing in foreign countries.

"Among the various branches of the industry, the position is worst in the cable business, while the installation and small-motor industry is in much the same state. In the incandescent-lamp industry provision had been made for an output of about 70,000,000 lamps. The export trade, taking before the war over 50 per cent of the total production, has fallen to below 25 per cent, and there is now lively competition abroad. Today there is no electrical engineering firm that is not in the gravest financial difficulties. Many firms have already had to think of curtailing their activities.

"Since the beginning of the war the production of the electrical engineering industry has declined heavily; during the war, because the factories were busy with war contracts which were mostly outside the ordinary scope of the electrical industry, and since the revolution because of the numerous strikes and the general unwillingness to work. According to a statistical return, there were eighty separate strikes in the Berlin metal industry during 1919, covering altogether 162 days. In one of the Siemens works—an example which is typical of the electrical engineering industry—only 63 per cent of the available working hours were worked. The work's tallies show for the current business year a production of 2,250 kg. per head, as against 4,400 kg. before the war. On the other hand, the wages paid per kilogram of finished goods rose from 43 pfennings to 2 marks in 1919 and are now to be reckoned at over 4 marks. Sharply rising prices led to the dissatisfaction of the workers, because their wages and salaries did not rise in the same proportion. The sales prices, however, are governed by the cost of materials, while the cost of necessary rubber, shellac, copper, etc., are absolutely dependent on the exchange."

Herr Henrich concluded by saying that the rebuilding of the industry would not be successful till the workers understood the realties of the economic position.

Metal Market Situation

STATISTICALLY the copper market shows little change. Quietness prevails, with producers nominally quoting from 18.75 to 19 cents delivered. A condition approaching a deadlock is present, as consumers are apparently trying to force down prices by holding off buying, while large producers for the most part are obstinately sticking to their 19-cent quotation. The situation seems to favor the seller, however, as buyers have apparently safeguarded their needs no further ahead than November, and it is only a question of time until they must come into the market.

The outside market has grown weaker and lower prices have brought out orders in considerable quantity. Second hands are selling as low as 18.12½ cents for September delivery and up to 18.50 cents for November. Standard copper at London remains dull but firm.

The zinc market is inactive under the influence of domestic dullness and the arrival of further reconsignments of the metal from abroad. This inactivity is reflected in a further slight decline in price for spot. Lead continues to be featured by the offer of foreign shipments at about 8.50 duty paid, though little interest is being taken at present.

NEW YORK METAL MARKET PRICES

	August 31	September 7
Copper	£ s d	£ s d
London, standard spot	95 0 0	95 0 0
	Cents per Pound	Cents per Pound
Prime Lake	18.50–18.75	18.25–18.50
Electrolytic	18.75–19.00	18.75
Casting	18.00	17.75
Wire base	22.50–23.00	22.50–23.00
Lead, trust price	9.00	9.00
Antimony	7.00	7.12½
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	8.30–8.40	8.25
Tin	46.00	45.25
Aluminum, 98 to 99 per cent.	35.10	35.10

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.50 to 16.00	15.50 to 16.00
Brass, heavy	9.25 to 9.50	9.00 to 9.25
Brass, light	7.25 to 7.75	7.25 to 7.50
Lead, heavy	7.50 to 7.75	7.25 to 7.50
Zinc, old scrap	5.25 to 5.50	5.25 to 5.50

THE WEEK
IN TRADE

Quiet prevails in the electrical industry in the Middle West, in the East and in the Intermountain section. In the latter district the public seems to be expecting lower prices. Sales in New England are proceeding at a brisk rate, and a good volume of business is also reported from St. Louis, but on the Pacific Coast conditions are uneven. An increase in demand seems to be expected more or less generally.

A shortage of water for power purposes in California has led to the curtailment of power there similar to wartime restrictions. Many cancellations in the lumber industry are being received in the Northwest and this is affecting sales. The price of lumber has dropped about 25 per cent in Chicago. New prices on some lines of electrical goods are also being quoted from Atlanta and Boston. Stocks are building up in good shape throughout the country to meet the anticipated fall trade. Deliveries are materially improved. In New England some overstocking is even reported.

Money seems to be slightly more plentiful in some sections, though collections are far from satisfactory. In St. Louis and in Portland territory credit is tight and bills are collected with difficulty. In other parts of the Northwest the credit situation has improved, and in the Intermountain section money is more plentiful as crops are being harvested. Collections in New England are also improving. A general scarcity of motors and porcelain is reported

except that the situation in the latter item is relieved in the Northwest, and demand for motors has fallen off in some quarters. Back orders prevent the accumulation of stocks, however.

NEW YORK

With the exception of occasional jobbers who say they have been having a good volume of business all along, distributors are finding trade very slow. No further reports have been received that the expected fall wave of buying has set in; in fact, jobbers state that sales are proceeding along the same quiet level of the past few weeks.

A happy result of this condition, however, is that stocks are building up fast and, with the better transportation facilities which most firms are finding, supplies of nearly all lines of goods should be in good condition to meet the heavier demand which is expected soon. Rigid conduit and porcelain are about the only items on which there is a decided shortage and demand for the latter material is slackening. A few specialities of various companies are in poor supply, but most of these delayed lines are now beginning to come in. Electric irons, dry cells, tape, lead and rubber-covered wire and sockets are more or less plentiful.

Residence construction remains as badly lacking as ever and electrical sales have suffered accordingly. Opinions on collections differ. Some jobbers say their bills are being paid fairly promptly, while others are finding collections slower and more difficult than earlier this summer.

Electric Irons.—Demand is rather light and consequently good stocks have accumulated. No trouble in obtaining supplies is reported.

Rubber Covered Wire.—Demand is fairly good and medium stocks are on hand. Shipments are coming along in good shape. No. 14 is quoted at from $11.50 to $13 per 1,000 ft.

Tape.—Good stocks of both friction and rubber are generally reported, though some jobbers have less of the latter type on hand. Demand is about normal. Most quotations range from 56 to 70 cents a pound on friction tape and from 52 to 68 cents on rubber.

Porcelain.—A representative jobber's prices on 3-in. tubes are $10.80 per 1,000; on knobs, $24 per 1,000; and on 2-wire unglazed cleats, $21 per 1,000, all in barrel lots. In some cases the shortage is so severe that prices are merely nominal, however, as stocks are spotty and badly broken. Shipments are irregular and demand slightly less.

Dry Cells.—Although some manufacturers are finding a good demand, jobbers say sales are light. Plentiful supplies are on hand, with No. 6 cells quoted at 32 cents in barrel lots and 45 cents for quantities less than a dozen.

Bells and Buzzers.—Demand is only average but the shortage of magnet wire is slowing up supplies and in some cases stocks are low while others have plenty. The dearth of residence construction is keeping down sales.

Lead Covered Wire.—Shipments are received in good shape and jobbers are well supplied. Demand is about normal. No. 14 duplex is quoted at about 8 cents a foot or from $57 to $60 per 1,000 ft. in large quantities.

Lamp Cord.—Some shortage is prevalent, particularly in the reinforced cotton cord. Large quantities are difficult to obtain and shipments are quoted at from two to three months. Some jobbers are having a heavy call while others say demand is not especially strong. Stocks are fairly good. Silk cord is quoted at $9 per 100 ft.; heavy reinforced cotton ranges from about $6 to $8 per 100 ft., and light from $5.25 to $6, depending upon the quantity.

Controlling Devices.—The Cutler-Hammer Manufacturing Company has increased its prices on this goods. The new discount sheet No. 5-A-1222 dated August, 1920, states that net prices are now obtained by adding 15 per cent to list prices. This applies only to bulletins dated March, 1916, or later.

Insulated Wire.—Price decreases averaging in general about 5 per cent on weatherproof and rubber-covered wire are announced by one manufacturer. Inquiries instituted among other producers, however, revealed no price changes. Factory stocks are either very low or else depleted, while demand continues strong. Deliveries are slow, ranging from about one to four months and even longer on some sizes.

Sockets.—Most jobbers are finding only a fair demand and have average stocks, but a few are behind on filling orders and are short on supplies, particularly the key type. Keys are quoted at 33 cents, keyless 30 cents and pulls 60 cents in standard packages, less 15 per cent.

Rigid Conduit.—Demand is holding up strongly and stocks are spotty with many sizes missing in the supplies on hand. One jobber just received seven or eight cars but shipments are slow and irregular. The price for ½ in. black ranges from $90 to $103 per 1,000 ft.

Fans.—Few if any price cuts have been made here, and although most jobbers have large stocks unsold, they prefer carrying them over to next year to reducing prices.

CHICAGO

Quiet continues to prevail. A great let-up in all lines of business is being felt, and this extends to the electrical industry particularly in retail trade. Sales of household appliances and all classes of material coming under the general classification of luxuries have been very light throughout the summer.

Adverse building conditions, so far as costs are concerned, have halted industrial development as well as housing construction. The price of lumber has consequently dropped close to 25 per cent and many cancellations have been received by machinery builders on orders intended for the equipment of new plants. This condition is helping one line of the electrical trade, however, for since new construction has stopped a vast amount of reconstruction and improvement is going forward in industrial plants and residence property. This is keeping the electrical contractor and contractor-dealer busy on rewiring jobs.

The current week's building permits total $520,000, of which $120,000 was for alteration jobs.

Motors.—While manufacturers are still unable to make prompt deliveries, the former pressure of back orders has materially lessened. No complaint is heard in regard to cancellations and recent price increases have had no evident effect on new business. It is said certain small factories are in a position to book additional orders.

Transformers.—Central station transformers still require from two to three months for delivery. Demand during the early summer was heavy and raw material difficulties delayed manufacturers. Small let-up is seen in the flow of new business.

Insulating Material.—Some jobbers have finally succeeded in building up nearly normal stocks. Tape and mica products are under steady demand, motor rebuilding absorbing a good share of the supply.

Porcelain.—Some quantity shipments have been received, but the volume has not been sufficient to supply requirements. Tubes are particularly in demand, with knobs and cleats in only slightly better supply. Most jobbers are unable to promise definite delivery dates.

Lock Nuts and Bushings.—A similar unfavorable condition exists in these items, as all incoming shipments are absorbed on arrival. Prices in this class of material are firm and stocks seriously depleted.

Magnet Wire.—The long-standing shortage continues. Certain makers, uncertain of the future, have withdrawn quotations and will make no definite promises of delivery. Labor troubles in the mills are partially to blame.

Heaters.—With but one or two exceptions, dealers and jobbers are buying very cautiously. The retail trade is uncertain as to how free trade is going to be this winter. There is also some question as to the price and supply of fuel. Manufacturers report the total volume of orders to date as less than at the same time last year.

BOSTON

Trade shows an excellent volume, although some jobbers report quieter conditions. An early revival of business is expected to follow the close of the holiday season, and fall orders are already being placed by retailers looking toward seasonal trade expansion. Prices have advanced slightly on rigid conduit. Stocks are believed to be above normal in many lines. One jobber stated recently that his stock, valued at more than $1,000,000, is about $350,000 too large, and consequently he is doing his utmost to reduce supplies before ordering extensively from manufacturers. An effort is being made to obtain larger profits on slow-moving supplies, through concessions by the manufacturer.

Collections are responding to vigorous efforts to improve them, but they are far from satisfactory. Many of the larger customers plead shortage of funds when pressed for payments. Deliveries are somewhat better, barring shortages in rigid conduit, motors and porcelain. Building contracts in New England for August, 1920, total $23,670,000 against $27,409,000 for August, 1919.

Rigid Conduit.—Prices have been advanced on some makes about 5 per cent. Stocks are low and spotty. The outlook for fall deliveries is not encouraging, especially in view of possible strikes in the steel industry.

Motors.—Increased factory facilities are slowly beginning to tell on the production record, but little improvement can be expected in deliveries until more back orders are filled.

Washing Machines.—By strenuous efforts, jobbers are able to keep up with the demand fairly well, but local stocks have little chance to accumulate. Twenty-five per cent off list being quoted on leading makes.

Sockets.—Orders are slowing down somewhat. Prices are steady, pulls quoting 50 cents net, keys 28 cents, and keyless sockets 26 cents in case lots. Good local stocks are in hand.

Wire.—Rubber-covered wire is reasonably plentiful, with steady prices. No. 14 quotes at $11.75 per 1,000 feet. Weatherproof and bare bases are running around 27 and 23 cents respectively. Magnet wire is still very scarce.

Heaters.—Stocks are being rapidly accumulated for the fall trade, which is expected to increase rapidly from now on. Recent coal price increases will undoubtedly help sales.

Tape.—Good stocks of black friction tape are reported. The ¾-in. size, in 25-pound lots, quotes 65 to 68 cents per pound in the better grades, and 70 cents for smaller lots.

Lamp Cord.—Silk cord is reported very short. Cotton-covered cord is in fair supply, No. 18 twisted pair quoting $43.70 per 1000 ft. list, with discounts up to 30 per cent on 5000-ft. lots.

Flexible Armored Conductor.—Prices are steady, with good supplies available.

ATLANTA

With the exception of a very few lines on which jobbers have as yet not obtained full data regarding the increase in freight, new prices are being quoted. Within the next few days quotations for the entire field of electrical material will have settled to the new level of prices without having encountered any noticeable resistance on the part of the public. The Sixth Federal Reserve District report of building permits for July shows a total number of 668 permits, valued at $3,804,535, this being a decrease of $1,309,736 over July of 1919. A better supply of labor is now available and conditions are more settled.

Schedule Material.—With the exception of items requiring porcelain there are very fair stocks on hand. A price increase of 10 per cent is to be noted in the more popular lines, such as rosettes, cutouts, fuses and so forth. Porcelain continues to be very short with poor shipments, there being practically no stocks of knobs and cleats available. Prices, rosettes, combination one piece, 12 cents; nail-it knobs, lots of from 500 to 4,000, $5.50 per 100; cleats, 1,850 and over, unglazed, 2 wire, $2.70 per 100.

Vacuum Cleaners.—The demand for this article continues to hold up satisfactorily with promises of even better business in the near future. Local stocks are reported in fair shape and shipments are coming through in a reasonable time.

Rigid Conduit.—No relief is being experienced in the galvanized line but stocks of black continue in fair shape, several large shipments having been received in the past week. The demand continues to hold up well and prices are quoted in lots of less than 2,500 pounds: Black, ½ in., $9.21 per 100 lb.; ¾ in., $12.24 per 100 lb.; 1 in., $18.79; 2 in., $39.39. Galvanized, ½ in., $9.72; ¾ in., $12.93; 1 in., $19.10; 2 in., $41.59.

Conduit Fittings.—The supply continues to hold up unusually well in the face of a strong demand, manufacturers apparently being in better shape than is the case in other lines.

Industrial Motors.—Little or no let up in demand is reported. Local stocks of the popular sizes, namely 220, 550 and 2,300-volt, three-phase type, are entirely exhausted and shipments range from eighteen to fifty weeks. Second-hand motors are being quoted on practically the same basis as new equipment. Special types of textile motors in the 550-volt type are on hand, however, in fair quantities.

ST. LOUIS

A normal easing off of general business was experienced in this territory during August, but nevertheless St. Louis electrical jobbers did more business than in August of last year. Large stocks of general merchandise in this territory are being reduced, but the stocks of electrical jobbers are increasing.

Building is practically at a standstill because of differences between the supply dealers and unions. Permits for new buildings during August represented only about one-third the investment of the same month in 1919. The lack of construction means that there has been little new house wiring for contractors, but there is a considerable amount of industrial installation work under way.

Jobbers' stocks are ample in most lines outside of small sizes of conduit, meters, transformers and linemen's tools. Shortages are being overcome as the improvement in transportation facilities continues. Dealers have full shelves as a result of early orders and sales are being fairly well maintained by intensive selling efforts. Credits are watched closely and collections from utility and industrial customers are very slow. The tendency has been for collections to become more difficult.

Wire.—Good stocks of both rubber-covered and weather-proof wire are in jobbers' hands. The demand for weather-proof is the greater. No. 14 rubber-covered is selling for $11.50 per 1,000 ft. in 5,000-ft. lots, and $12.25 in lots from 1,000 to 5,000 ft. No. 6 weather-proof is quoted at $32.35 per 100 lb. in lots of 1,000 lb. or more.

Rigid Conduit.—Very little of the ½-in. and ¾-in. sizes is available but there are good stocks of the larger sizes. Demand is fair. The price was increased last week and card No. 46 is now effective. The price for 1-in. conduit is $148 per 1,000 ft. in lots of 5,000 ft.

Transformers.—There has been a steady demand from industrials for power transformers of from 200 kva. to 500 kva., for use in connection with the purchase of primary central station power service. Deliveries of six or seven months are now being promised on these units.

Linemen's Tools.—Local stocks are generally depleted and it is so difficult to obtain supplies even on orders placed last winter, that at least one jobber is considering the advisability of giving up the line entirely.

Guy Wire.—Stocks have been reduced almost to the vanishing point and it cannot be said with any certainty as to when they will be replenished. A local manufacturer says the shortage is due to inability to get the galvanized steel wire used in making up the strand. The price of quarter-inch galvanized stranded steel wire is $1.75 per 100 lb. with a discount of 25 per cent in quantities of from 1,000 to 5,000 lb., and 35 per cent off for orders of 5.000 lb. or more.

Cross Arms.—Both stocks and demand are good. Jocelyn of Chicago has issued a new price list, F 25, effective Sept. 1 for Washington fir and yellow pine cross arms. The new list represents an advance in price to cover the increased freight rates.

Meters.—House type meters of the 5-amp. size are in demand by central stations which did not order their year's requirements early in the spring. There are practically no stocks and it is almost impossible to get any quantity under three months.

SAN FRANCISCO

Business in northern California is slowing appreciably, while in the southern part of the state it is very brisk. This is evidenced by the value of the building permits issued during August, 1920. For the principal cities these figures were as follows: San Francisco, $1,456,000; Oakland, $672,000; Los Angeles, $6,870,000; San Diego, $483,000. This compares with figures of $2,788,000, $921,000, $2,403,000 and $130,000, respectively, in the same cities for August, 1919.

Three dry winters and the need of water for irrigation have resulted in strict orders for power conservation similar to war-time restrictions. Electric signs are banned and street lighting has been cut to a minimum. During this inforced inactivity, however, plans are being pushed to care for the future. The Great Western Power Company, now distributing 86,000 hp., will have 140,000 hp. available shortly after the first of the year in one of the most compact plants in the state. The cable is on the ground, nearly all the steel towers have been placed, and the wire is being rapidly strung. The Pacific Gas & Electric Company through its Pitt River project will shortly be able to deliver 220,000 volts current. The development of the San Joaquin valley, which has been hampered during the past year by lack of power, will be mightily assisted by the completion of the new San Joaquin Light & Power Company project. Efforts are being made to interest the electrical trade in the purchase and holding of valuable power securities, as census estimators state that an electrical pumping installation on a farm increases its yield per acre from three to ten fold.

Household Appliances—Shipments are being received in better quantities from the factory, and nearly all jobbers and dealers now have fair stocks. Buyers expect a considerable price increase in the near future.

Lamps.—Deliveries as a whole are excellent, and business is showing signs of the fall rush.

SEATTLE—PORTLAND

From present indications fall business in the electrical industry will be good, as already sales in certain lines, such as heating appliances, household equipment, lighting fixtures and lamps have begun to show a healthy movement. Contractor-dealers report a considerable amount of new work, and sales of both jobbers and retailers for the past week show improvement. Bankers who last spring were predicting a strained credit situation during the crop-moving period now adhere to the belief that no unusual disturbance will be witnessed.

Orders for lumber in the Northwest have slumped heavily as a result of the application of freight rate increases and cancellations of old business are being made. New business seems destined to continue at low ebb until transcontinental carriers inaugurate their contemplated modifications of the new rates.

Portland jobbers report business as running along on about an even keel. Prospects are not particularly bright. The credit situation continues to tighten and collections are slow. This as usual reflects itself in the amount of business transacted. Contractors say business is good at present, with considerable work in prospect for the future. Many of the larger contractors have enough work ahead to keep them busy for the next two or three months. Competition is keen on larger contracts but many of the standard firms depend upon regular customers where competition is not felt. The business of retail stores varies from fair to good, several report that August sales mark the month as the banner one of the year thus far. Cash sales are good, but collections on accounts are slow. The credit situation is being watched carefully.

Motors.—In Portland territory manufacturers report stocks of motors, transformers and meters are low and difficult to replenish. The call for motors and transformers is very light. In Seattle like conditions exist, except in fractional size motors. However, in both districts the demand is far in excess of available stocks.

Flashlights.—Demand the past two weeks has been steadily increasing. Sales campaigns did not bring the results anticipated. Seattle jobbers particularly report no difficulty in securing supplies.

Insulating Material.—Demand is picking up and tapes, mica material and fibre are showing a good movement. Prices are steady and stocks in excess of demand.

Wire.—A fairly satisfactory stock of rubber covered is on hand in assorted sizes, but some jobbers report weather proof continues scarce. Prices show no recent change.

Lock Nuts and Bushings.—The shortage of these fittings has been overcome, because of the decreasing demand and an improvement in shipping. No price changes are reported recently.

Porcelain.—Recent shipments have built up jobbers' stocks in a satisfactory manner and the shortage is over. Demand is now light.

SALT LAKE CITY-DENVER

Jobbers express the belief that the purchasing power of the public is substantial and that it is not altogether the lack of money that accounts for the present widespread wave of conservatism in buying. The public seems to be waiting for prices to fall, and the recent downward tendency in some lines of merchandise has given some warrant for this attitude.

The vacation period is nearly over and business is generally settling down to a normal level. This is already being reflected in improved retail sales. The electrical market is picking up, especially in all kinds of household appliances. Sales for August in nearly all electrical lines show an increase over July. Dealers attribute this to the fact that more money is circulating as the crops are being harvested and marketed. From all indications September will be a better month than August.

Jobbers in some quarters say they could sell more merchandise to dealers if they wished to be more lenient in the matter of credit. They are refusing to sell extensively on a credit basis, however, and are admonishing retailers to establish their own business on the same stable foundation. The last two or three weeks show a decided improvement in collections. Deliveries are gradually returning to normal. Especially is there a gratifying improvement in the delivery of all kinds of domestic appliances.

Washing Machines.—With the approaching end of the vacation season a greater demand is becoming noticeable. Most factories are in a position to make satisfactory deliveries.

Vacuum Cleaners.—There is a decided increase in sales. This is attributable in part to the need of equipment for fall house cleaning. Dealers are showing a tendency to concentrate on cleaners in their advertising.

Conduit.—There is still a serious shortage of conduit for construction work. Manufacturers are not able to meet the orders as demand is unusually large just at present.

Wiring Devices—There has been a recent advance in prices due mainly to the increased freight rate schedule. Porcelain factories in many cases are unable to keep their jobbers sufficiently stocked.

Street Lighting Equipment.—Cities and municipalities show little interest in new lighting equipment for streets. In several cases orders for new installations have been cancelled. It is found impossible to finance civic improvements involving any large outlay of money.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Rotary Rectifier for Battery Stations

A rotary rectifier for charging batteries from a 115-volt, 60-cycle line has been developed by the France Manufacturing Company, Berea Road and West

CHARGES ONE TO TWENTY-EIGHT 6-VOLT BATTERIES FROM A.-C. LINE

104th Street, Cleveland, Ohio. This rectifier, which gives from 7½ volts to 105 volts direct current, is made in three types of 1,000, 1,500 and 2,000 watts rating. From three to forty-two cells may be charged on the two smaller outfits and from three to eighty-four on the larger outfits. The outfits weigh 75, 100 and 125 lb. respectively. The operation is entirely automatic. The voltage and current is readily adjustable for different numbers of batteries.

Combination Fan and Household Heater

A combined fan and heater has been announced by the Thermo Fan Electric Company of New York City and its distributers, the S. O. S. Electric Sales Company of 2 Columbus Circle, New

FAN DISTRIBUTES HEATED AIR

York City. This "Triplex" heater consists of a standard fan to the guard of which is attached a nichrome heater, through which the air from the fan passes. Fan and heater have independent connections, attaching to any socket, and combined, in the domestic size, require 660 watts. The fan-heater is made in larger sizes for industrial purposes. The fan may be used alone for cooling purposes.

Portable Power Stand

The Delco-Light power stand, manufactured by the Delco-Light Company, Dayton, Ohio, is built to permit of driving household and farm appliances from the same motor. The ¼-hp. motor is mounted on a tripod and drives through a 5-step pulley. Weight is 50 lb.

Plug Bushing Which Grips Cord

For taking strain off the binding screws of plugs a new bushing has been developed by the Bryant Electric Company, Bridgeport, Conn. The hole in the bushing has a number of inwardly projecting bosses which serve to securely grip the outer surface of the wire

BUSHING GRIPS WIRE, TAKING STRAIN OFF BINDING SCREWS

around its entire circumference. Thus the strain on the wire is taken by the bushing and not by the binding screws. The threading is standard ⅜-in. iron pipe size. It is therefore possible to attach the cap to socket handles, etc.

Notes on Recent Appliances

Electric Dishwasher

The Tupper Manufacturing Company, 1122 West Forty-seventh Street, Seattle, Wash., has placed on the market a motor-driven dishwasher of large capacity.

Storage Battery

An automobile-type storage battery with hard separators has been developed by the Duplex Storage Battery Company, Edison and Market Streets, Milwaukee, Wis.

Electric Stove

An electric stove for factory use has been placed on the market by the S. U. E. Company, 89 Beach Street, Boston, Mass.

Oil-Engine-Driven Farm-Lighting Plant

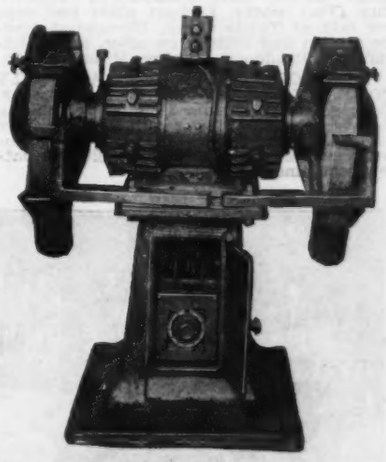
For operation on thin crude oil, kerosene and low-grade fuel oil down to 28 deg. Baumé, a farm-lighting plant has been designed by the Petroleum En

RUNS ON LOW GRADE OILS

gine & Manufacturing Company, Insurance Exchange Building, Chicago. The outfit consists of a 3-hp. vertical engine, a Westinghouse Electric 1.5-kw. generator and control panel and a storage battery.

Self-Contained Motor-Driven Tool Grinder

A push button on top of the motor frame actuates a starter with a speed-adjusting rheostat, all of which are located in the bottom of the machine frame of the tool grinder just placed upon the market by the U. S. Tool



MOTOR AND CONTROL APPARATUS TOTALLY ENCLOSED

Company of Cincinnati, Ohio. The grinder shown is equipped with a 5-hp. direct-current shunt-wound adjustable speed (1,120 to 1,600 r.p.m.) 230-volt Westinghouse motor.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE GEORGE CUTTER WORKS of the Westinghouse Electric & Manufacturing Company, South Bend, Ind., is making extensions which will double its manufacturing capacity and will include new foundry space of 64 x 112 ft. and a second floor, measuring 66 ft. x 250 ft., for assembling and storage rooms. In addition outdoor storage space has been acquired which will increase the facilities greatly.

THE WALKER & PRATT COMPANY, 31 Union Street, Boston, manufacturer of stoves, etc., has awarded contract for an addition to its plant. The increased space will be used for the manufacture of electric stoves and to increase the output of gas stoves.

THE ARROW ELECTRIC COMPANY, Hartford, Conn., manufacturer of switches and other electrical equipment, has awarded contract for construction of an addition to its plant, 33 ft. x 40 ft.

THE NATIONAL LAMP WORKS of the General Electric Company, with main offices in New York City, will build two factories in Indianapolis to manufacture incandescent lamps representing an investment of about $2,000,000 on a site at East Washington and Gray Streets. It is proposed to build a finishing plant of three stories and a basement 111 x 240 ft., to cost about $1,000,000, and a glass works of two stories and a basement 80 x 200 ft., at a cost of about $750,000. About 1,200 persons will be employed in the finishing plant and 500 at the glass works. The proposed plant will manufacture miniature incandescent and automobile lamps, and will have a capacity of 160,000,000 lamps a year.

CARL G. BARTH & SON, consulting engineers, announce that they have opened an office in the Fuller Building, 10 South Eighteenth Street, Philadelphia, where they will continue their specialization in production and costing mthods, etc., based on the Taylor system of scientific management.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., held its thirty-fourth annual outing and basket picnic at Kennywood Park, Pittsburgh, on Aug. 14, which was attended by more than 40,000 employees of the company and their families. Among the companies represented at the outing were: the electric, machine and meter works, East Pittsburgh; Trafford City (Pa.) works, Linhart plant and copper mill at Turtle Creek, Homewood service station and Pittsburgh office, and Pittsburgh & Braddock foundry, Braddock, Pa.

THE SOUTHWESTERN BATTERY COMPANY, 1707 Jackson Street, Dallas, Tex., recently organized, is contemplating the construction of a new plant, 50 ft. x 125 ft., to cost about $20,000. The company proposes to manufacture electric battery equipment.

THE KINGSBURG-SAMUEL ELECTRIC COMPANY, 213 North Calvert Street, Baltimore, Md., has acquired a three-story building at 530-32 North Calvert Street, where it will establish a new plant for the manufacture of electrical apparatus.

THE UNITED STATES LIGHT & HEAT CORPORATION.—Interests connected with the Willys-Overland Company, Toledo, Ohio, and affiliated concerns have obtained a substantial interest in the United States Light & Heat Corporation, Niagara Falls, manufacturer of storage batteries, electric lighting systems for railroads, etc. The following officers have been elected: John N. Willys, chairman of the board; J. Allen Smith, president; E. H. Gold, vice-president of the board; C. L. Lane, vice-president and general manager; H. H. Knapp, treasurer, and H. H. Van Nest, vice-president and secretary.

THE DUPLEX STORAGE BATTERY COMPANY, 537 Edison Street, Milwaukee, Wis., has purchased the plant of the former Beaver Dam (Wis.) Manufacturing Company which it will remodel and equip for the manufacture of storage batteries. The company is making arrangements to increase its capital stock from $60,000 to $500,000.

THE FORT WAYNE ELECTRIC WORKS of the General Electric Company, Fort Wayne, Ind., has filed plans for the erection of a building at Wall Street and Broadway, to cost about $25,000.

THE INTERNATIONAL RADIO TELEGRAPH COMPANY, Pittsburgh, Pa., manufacturer of radio apparatus, has filed notice of change of name to the International Devices Company.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has filed plans for the construction of a one-story building at its plant at Columbia Avenue and Putnam Street, Baltimore, Md., recently acquired from the government. The factory will be used for the manufacture of electric switches and other specialties.

METROPOLITAN ELECTRICAL SUPPLY COMPANY, Philadelphia, Pa., has leased the property at 45 North Seventh Street, in that city, where it will operate a branch establishment.

THE APEX ELECTRICAL DISTRIBUTING COMPANY, Cleveland, Ohio, held a convention at the Hollenden Hotel, Cleveland, July 13, 14 and 15, which was attended by sixty-eight Apex district sales managers, their assistants and distributers, and Apex department managers. With Apex cleaner sales increasing rapidly, new sales policies were outlined and progressive business methods unfolded by which the company plans to make even greater progress during the next year.

THE BLUE BIRD MANUFACTURING COMPANY, St. Louis, Mo., manufacturer of the Blue Bird electric clothes washer, has sold its property and good will to the Davis Sewing Machine Company, Toledo, Ohio. The latter company will continue the manufacture of the Blue Bird clothes washer and will operate the business on a large scale. As far as possible the old distributers will be retained.

THE SAFETY CAR HEATING & LIGHTING COMPANY has awarded contract for alterations in the former plant of the Marlin-Rockwell Company, New Haven, Conn., recently taken over by the company.

THE OHIO GENERATOR COMPANY, Wheeling, W. Va., manufacturer of generator equipment, etc., has been reorganized and several new directors have been elected. Plans are being considered for extensions. Henry Miller of Miller & Stein, is chairman of the board.

Supply Jobbers' Notes

JAMES W. POOLE, Inc., electrical supply jobbers since 1887 at Boston, will be established after Sept. 1 at 197-203 Congress Street, Boston. The former wholesale and retail quarters of the company, at 16 Columbia Street and 64 Kingston Street respectively, will be given up, and the business of the establishment henceforth will be chiefly wholesale. About 12,000 sq.-ft. of floor space is available at the company's new home.

THE CARTER ELECTRIC COMPANY, Atlanta, Ga., is erecting a new warehouse on Haynes Street, to cost about $250,000. The new building will give the company about 55,000 ft. of floor space. Arrangements have been made for recreational devices for the employees.

Foreign Trade Notes

LARGE INCREASE IN CAPITALIZATION OF ELECTRICAL WORKS IN GERMANY.—The Westphalian United Electric Works has increased its capital from 3,000,000 marks to 12,000,000 marks. It is also announced that the Allegemeine Elektricitats-Gesellschaft (the A. E. G.) of Germany has decided upon an issue of 250,000,000 marks in preferred stock, to provide the company with an enlarged capital corresponding to the generally higher level of prices.

DEMAND FOR ELECTRICAL EQUIPMENT AND MACHINERY IN SPAIN.—At the present time the demand for electrical equipment and machinery is very brisk and will probably develop considerably during the coming year. There are now some 2,800 electric plants in the country, producing annually 54,800,000 kw.-hr. of electricity. Hydro-electric plants are in the lead nd plans are being considered and prepared for still greater use of electricity for the rapidly multiplying industries.

SALES CONVENTION OF THE APEX ELECTRICAL DISTRIBUTING COMPANY

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A merantile company in India (No. 33,569) desires to purchase and secure an agency for the sale of electrical goods, etc.

A commercial agent in Brazil (No. 33,573) desires to represent firms for the sale of electrical supplies, etc., in that country.

A mercantile firm in Turkey (No. 33,576) desires to purhase copper wire, plain and silvered.

A commercial agency firm in Brazil (No. 33,583) desires to secure the representation of firms for the sale of electrical goods, etc.

A miner in Spain (No. 33,591) desires to secure an agency for the sale of complete electrical installations for mines and mining industry.

A co-operative mercantile company in Australia (No. 33,598) desires to purchase and secure an agency for the sale of electric-lighting plants, driven by gasoline engine, etc.

Trade Publications

SYNCHRONOUS CONDENSERS.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 41,311, superseding bulletin No. 4859, covering its synchronous condensers.

INSULATING FABRICS AND LINK INSULATORS.—The General Electric Company, Schenectady, N. Y., has published bulletins Nos. 48,715 and 49,400, describing respectively the G-E insulating fabrics and the Hewlett link insulator.

COPPER WIRE, CABLES, ETC.—The Copper Clad Steel Company Rankin, Pa., Braddock post office, has issued five four-page leaflets covering its "Copperweld" bond wires for aerial cables, signal service, low-voltage power transmission and for power transmission and distribution.

FUEL-SAVING DEVICES.—Bulletin 111 issued by the Uehling Instrument Company, 71 Broadway, New York City, describes and illustrates the standard Uehling CO$_2$ meters, both single and multiple units.

INSULATING COMPOUNDS.—"G-E Insulating Compounds" is the title of bulletin No. 48,704A, published by the General Electric Company, Schenectady, N. Y., covering its insulating compounds, including insulating varnishes, japan oils, etc.

WATER SOFTENERS, FILTERS, ETC.—The Permutit Company, 440 Fourth Avenue, New York City, has issued bulletin No. 101, entitled "Permutit Water Rectification Systems," in which it describes and illustrates its products, including water softeners, filters, manganese removal equipment, etc.

ELECTRIC DRILLS.—The Independent Pneumatic Tool Company, 600 West Jackson Boulevard Chicago, is distributing circular No. 33, describing its "Thor" universal electric drills, grinders, etc.

STEEL BUILDINGS—"Prudential Steel Buildings" is the title of catalog No. 21 issued by the Blaw-Knox Company, Pittsburgh, Pa., covering its line of galvanized sheet-steel buildings.

COUNTERS.—"Veeders Counters Checking Up Production" is the title of catalog No. 1901 issued by the Veeder Manufacturing Company, Hartford, Conn., describing its products, including cyclometers, odometers, counters, tachometers, fine die castings, etc.

New Incorporations

THE HOME LIGHT & POWER COMPANY, Columbus, S. C., has been incorporated by S. O. and M. G. Lindeman. The company is capitalized at $20,000 and proposes to engage in the manufacture of domestic lighting apparatus, heating appliances, etc.

THE JAMESTOWN ELECTRICAL ENGINEERING CORPORATION, Jamestown, N. Y., has been incorporated with a capital stock of $50,000 to manufacture electrical equipment and appliances. The incorporators are C. S. Cole, F. B. Smith and A. E. Westburgh.

THE CANADIAN EDISON APPLIANCE COMPANY, Ltd., Toronto, Can., has been chartered with a capital stock of $1,000 000 to manufacture electric specialties, machinery, etc. The incorporators are: William A. J. Case, 94 Leuty Avenue; James B. Taylor, 801 Dominion Bank Building; George E. Atwood and others, all of Toronto.

THE OCEANIC POWER COMPANY, Charleston, S. C., has been chartered with a capital stock of $10,000. The officers of the company are: William Gregersen, president; J. E. Martin, Jr., vice-president, and William P. Tillinghast, secretary and treasurer.

THE BURNSVILLE WATER & LIGHT COMPANY, Burnsville, W. Va., has been incorporated with a capital stock of $75,000 by W. E. Marple, John I. Bender and J. L. Coberly.

THE HODGSON ELECTRIC APPLIANCE COMPANY, Glens Falls, N. Y., has been incorporated by E. J. West, W. D. Hodgson and D. F. Imrie. The company is capitalized at $100,000 and proposes to engage in the manufacture of electrical apparatus.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

SKOWHEGAN, ME.—The Central Maine Power Company, 40 Water Street, Augusta, contemplates the erection of a hydro-electric plant to develop 12,000 kw. The cost is estimated at about $1,350,000. Frank H. Mason is chief engineer.

NORWOOD, MASS.—The Hollister Mills, Lenox Avenue, will soon award the contract for the construction of a mill to cost about $300,000. Electric light and power equipment will be installed. J. W. Beal, 62 Summer Street, Boston, is architect.

Middle Atlantic States

BROOKLYN, N. Y.—Bids have been received by the Board of Education, Room 2800, Municipal Building, Manhattan, for the installation of electric light systems in Brooklyn Public Schools Nos. 10, 23, 35, 48, 53, 77, as follows: T. F. Jackson, $8,479; $10,647; $10,186; $2,728; $3,840; $9,484. Jandous Electric Company, $9,100; $10,240; $9,325; $1,925; $3,580; $9,285. Croker National Engineering Company, $8,827; $10,497; $9,780; $1,966; $3,814; $9,095.

CLIFTON PARK, N. Y.—The Adirondack Power & Light Corporation, Schenectady, has petitioned the State Public Service Commission for permission to erect an electric plant in Clifton Park and in certain towns in Montgomery and Fulton Counties. D. E. Peck is secretary.

MINEOLA, L. I., N. Y.—The Nassau & Suffolk Lighting Company has been authorized by the Public Service Commission of the Second District to issue $436,000 in bonds, the proceeds to be used for extensions and improvements to its plant and distribution system.

ROME, N. Y.—The Rome Wire Company has filed plans for the construction of a power house at the junction of Kensington Avenue and the Delaware, Lackawanna & Western Railroad tracks, to cost about $15,000.

ALLENTOWN, PA.—The Allen Tire & Rubber Company, 510 Hamilton Street, has awarded the contract to the Allentown Construction Company, Fifth and Hamilton Streets, for the erection of a factory for the manufacture of tires and tubes, to cost about $2,500,000. Electrical equipment will be installed.

WATSONTOWN, PA.—An issue of $15,000 in bonds has been authorized by the citizens for improvements to the municipal power plant.

BALTIMORE, MD.—The Whitaker Paper Company, 415 Guilford Avenue, received bid from B. F. Bennett Building Company, 123 South Howard Street, for the erection of a warehouse building to cost about $1,000,000. Wiring and fixtures for electric lights will be installed.

PORTSMOUTH, VA.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Sept. 14, for 1,000 ft. single conductor cable for Portsmouth. (Specification 6271.)

WASHINGTON, D. C.—Bids will be received at the office of the Chief Signal Officer, U. S. A., War Department, Washington, D. C., until Sept. 14, under PR 4402—1CP, for furnishing two telephone switchboards, 100-line, local battery, jacks and signals, one position to be serially numbered, and 15 cord circuits with single supervision.

North Central States

AKRON, OHIO.—A boulevard lighting system for Storer Avenue has been approved by the City Council.

AKRON, OHIO.—The Portage Lakes Improvement Association has been assured by the Northern Ohio Traction & Light Company of Akron that a high-tension light line will be erected to the lakes next year.

CLEVELAND, OHIO.—It has been reported that the Wheeling & Lake Erie Railroad, Leader-News Building, Cleveland, contemplates electrification of its lines including the erection of a power house near Conesville and high-tension transmission lines to Akron and Canton.

CLEVELAND, OHIO.—Contracts have been awarded by the city officials as follows: for turbo-generator, to the Allis-Chalmers Mfg. Company, Cleveland, at $188,000; switchboard to the Westinghouse Electric & Manufacturing Company, 6905 Susquehanna Street, Pittsburgh, Pa., at $12,707; condenser and auxiliaries to the Wheeler Condenser Company, Indianapolis, Ind., at $65,000.

ELYRIA, OHIO.—The Reliance Crane Company has plans under way for the construction of a factory and power house to cost about $125,000. Watson Engineering Company, Hippodrome Building, Cleveland, are engineers.

COLUMBIA CITY, IND.—The City Council has filed petition with the Public Service Commission for approval of an issue of $75,000 in bonds for the installation of new equipment in and repairs to the Columbia City Light, Power and Water Plant.

BEAVER DAM, WIS.—The Wisconsin Power, Light & Heat Company contemplates the erection of a power house at Beaver Dam. Hutter Construction Company, 128 Western Avenue, Fond du Lac, are engineers.

HUDSON, WIS.—The Burkhardt Milling & Power Company will soon award the contract for the erection of a power house to cost about $40,000. Holland, Ackerman & Holland, 122 North Fourth Avenue, Ann Arbor, Mich., are engineers.

MILWAUKEE, WIS.—The Sewerage Commission contemplates the erection of a power house to cost about $250,000 including equipment, in connection with the sewage system.

CRYSTAL LAKE, IOWA.—Bids will be received by F. A. Gabrielson, secretary, until Sept. 30, for electrical work, heating and plumbing for the Consolidated Independent School District of Crystal Lake.

HOPKINTON, IOWA.—The Hopkinton Electric Light & Power Company has plans under way for the erection of a power house to cost about $35,000. Holland, Ackerman & Holland, 122 North Fourth Avenue, Ann Arbor, Mich., are engineers.

STOCKPORT, IOWA.—The Van Buren Light & Power Company of Stockport has applied to the State Railroad Commission for permission to erect electric transmission lines to Farmington, Bonaparte, Keosauqua, Cantril and Milton.

BURLINGTON, KAN.—A charter for the organization of a local corporation capitalized at $25,000 has been granted for the installation of an electric lighting plant.

OSAWATOMIE, KAN. — Bonds to the amount of $85,000 have been voted for extensions and improvements to the municipal light and water plant.

OTTAWA, KAN.—The proposal to issue $195,000 more in bonds will be submitted the voters at a special election soon, of which $165,000 will be used for improvements to the light and water plant.

TOPEKA, KAN. — The Security Benefit Association has preliminary plans under way for the construction of a hospital and detention building including a power house to cost about $300,000. Schmidt, Garden & Martin, 104 South Michigan Avenue, Chicago, Ill., are engineers.

Southern States

WINNSBORO, S. C. — The Winnsboro Mills contemplates the installation of 3,000 kva. bank of transformers in a new mill now under construction.

TOCCOA, GA.—The Toccoa Falls Light & Power Company has work under way on the construction of a hydro-electric plant on Toccoa Mountain. Plans include the erection of a dam.

DELRAY, FLA. — Bids will be received until Sept. 25 for the installation of an engine and equipment for electric light unit. W. A. Brennan is town clerk.

GREENSBORO, ALA.—The city officials contemplate the establishment of an electric light and water plant to cost about $12,000.

JUDSONIA, ARK.—The Arkansas Hydro-Electric Development Company, Little Rock, contemplates the erection, by day labor, of the first unit of a hydro-electric plant on the Little Red River, about eighteen miles from this place, to include a 10,500-hp. power plant and a dam, at a cost of about $1,208,000. Dickinson & Watkins, Little Rock, are resident engineers.

Pacific and Mountain States

EVERETT, WASH.—The development of a power project on the Sultan River and Olney Creek in Snohomish County is being planned by the Sound Power Company. H. O. Pond, 25 Broad Street, New York, N. Y., is president.

SEATTLE, WASH.—Contract has been awarded to Thomas D. MacNeil, of Mt. Vernon, by Washington Dairymen's Association for the erection of a main building, power house, etc. Cost is estimated at about $88,000. P. W. Shubert, Railway Exchange Building, is engineer.

PORTLAND, ORE.—The Columbia Valley Power Company, organized under the laws of Delaware, has applied for permission to operate in Oregon. N. D. Simon, Board of Trade Building, Portland, is the Oregon representative of the company.

ROUNDUP, MONT.—The installation of an ornamental street-lighting system will be made on certain streets of the city, to cost about $25,000.

PUEBLO, COL.—The Colorado Fuel & Iron Company contemplates the erection of a power house and the electrification of some mills.

Canada

ST. JOHN, N. B.—The Federal Department of Marine and Fisheries has appropriated $25,000 for the installation of radio stations in St. John Harbor.

WINDSOR, N. S.—A local company is being organized for the development of a project to consist of a pulp mill, 3,000-hp. power plant, etc., to cost about $250,000. T. B. Atkins, of Windsor, and Wright & Jodrey, of Wolfville, are interested.

FENELON FALLS, ONT. — Plans are under way for the construction of a new waterworks and fire protection plant. Electrically driven centrifugal pumps will be installed. Oliver Smith, of Lindsay, is engineer.

KAPUSKASING, ONT. — The Government has decided to aid in the development of water power and the establishment of a townsite at this place.

TORONTO, ONT. — The Marconi Wireless Company of Canada, Ltd., contemplates the erection of an experimental station for wireless communication between Canada and England.

COATICOOK, QUE.—A by-law has been passed authorizing borrowing $60,000 for the construction of a new dam and power house.

Miscellaneous

VILLA ACUNA, COAHUILA, MEXICO. —The Mexican Government has granted a concession to Antonio Guijosa for the construction of an electric light and power plant at this place. The plant will be of sufficient size to furnish power for the operation of pumping plant for irrigation purposes on the American and Mexican sides of the Rio Grande River.

(Issued Aug. 24, 1920)

1,350,925. INSULATION; Giuseppe Faccioli, Pittsfield, Mass. App. filed March 20, 1917. Oil filled bushing.

1,350,933. ALTERNATED TIME-CONTROLLED MECHANISM FOR IRONS; Jose A. Oca-Balda, New York, N. Y. App. filed Aug. 1, 1919. Clock controls current.

1,350,936. INSULATOR; Frank W. Peek, Jr., Pittsfield, Mass. App. filed March 15, 1917. Combination of conducting shapes for stress distribution in bushing.

1,350,937. CONTROLLER FOR ELECTRIC MOTORS: Charles I. Perry, Schenectady, N. Y. App. filed Dec. 6, 1918. Manual controller operates motor controller to give definite speeds.

1,350,954. OPTOPHONE; Archibald Barr and William Stroud, Anniesland, Glasgow, Scotland. App. filed Nov. 26, 1919. Produces musical notes for blind to read printing.

1,350,956. ALKALINE ACCUMULATOR; Antoine Marius Cave, St. Etienne, France. App. filed Nov. 7, 1918. Metallic cloth wrapped around electrodes.

(Issued Aug. 31, 1920)

1,351,019. ELECTRIC REGULATING RHEOSTAT: Lawrence Boothman, Manchester, England. App. filed March 4, 1915. Two elements.

1,351,023. CONTROLLER FOR SMALL MOTORS; Joseph L. Chantemerle, Turtle Creek, Pa. App. filed Jan. 14, 1918. For foot operation.

1,351,027. RELAY; David C. Davis, Wilkinsburg, Pa. App. filed June 17, 1918. Frequency actuated.

1,351,030. ARC-WELDING SYSTEM; Hans Fahnoe, Pittsburgh, Pa. App. filed Sept. 3, 1919. Improved starting characteristics.

1,351,033. SYSTEM OF DISTRIBUTION; Charles Le Geyt Fortescue, Pittsburgh, Pa. App. filed Dec. 4, 1915. Regulation of voltage.

1,351,035. DYNAMO-ELECTRIC MACHINE: Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Dec. 14, 1915. Dynamotor voltage ratio varied.

1,351,036. DYNAMO-ELECTRIC MACHINE: Rudolf E. Hellmund, Pittsburgh, Pa. App. filed May 8, 1916. Dynamotor voltage ratio varied.

1,351,042. SYSTEM OF VENTILATION FOR TRANSFORMERS; Carl G. Jones, Wilkinsburg, Pa. App. filed Aug. 3, 1917. Aspirator draws air from above oil.

1,351,054. ELECTRIC SADIRON; Edwin Miller, Hartford, Conn. App. filed Jan. 19, 1920. Cord support.

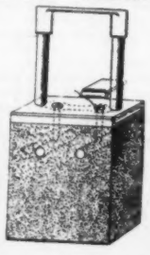
Record of Electrical Patents

Notes on United States Patents

1,351,055. ELECTRIC REGULATION; George G. Milne, Rye, N. Y. App. filed Feb. 17, 1917. Self-regulating dynamo.

1,351,059. SHUNT ATTACHMENT FOR BRUSHES; Frank D. Newbury, Pittsburgh, Pa. App. filed July 6, 1917. Detachable brush.

1,351,061. TRANSFORMER; John F. Peters, Pittsburgh, Pa. App. filed April 6, 1917. Eliminates distortions in three-phase transformers star connected.



1,351,059. Shunt Attachment for Brushes

1,351,074. CONDENSER; Phillips Thomas, Edgewood Park, Pa. App. filed June 15, 1917. High dielectric strength.

1,351,144. PROCESS OF ELECTRICALLY DEPOSITING ALUMINUM; Glen L. Williams, New York, N. Y. App. filed March 12, 1918. Producing aluminum from compound dissolved in liquid anhydrous vehicle.

1,351,150. DEVICE FOR ATTACHING ELECTRIC LIGHT FIXTURES TO OUTLET BOXES; Richard Battle, Okmulgee, Okla. App. filed April 11, 1919. For fans or the like.

1,351,191. ELECTRICAL CONNECTING DEVICE; Maximilian Sidon, Bridgeport, Conn. App. filed Nov. 24, 1916. Contact blades interchangeable with receptacles.

1,351,203. PLUG CUT-OUT BASE; Robert C. Cole, Hartford, Conn. App. filed Feb. 27, 1919. Rapidly assembled.

1,351,214. ELECTRIC SWITCH; Norman W. Nutt, Trenton, N. J. App. filed Jan. 29, 1919. Lamp socket.

1,351,254. AUDIPHONE; Charles Larrick, Los Angeles, Cal. App. filed March 26, 1919. Improved type.

1,351,255. LIGHTING FIXTURE; Abraham Lazerson, Chicago, Ill. App. filed Jan. 26, 1920. Directs large part of light down.

1,351,270. SQUIRREL CAGE WINDING CONSTRUCTION; Nathan Wilkinson, Milwaukee, Wis. App. filed Aug. 27, 1914. An improved method of welding end members.

1,351,271. METHOD OF AND APPARATUS FOR ELECTRIC WELDING; Nathan Wilkinson, Wauwatosa, Wis. App. filed Aug. 27, 1914. For welding end bars.

1,351,294. ELECTRIC MOTOR; Nils D. Levin, Columbus, Ohio. App. filed April 7, 1916. For use in mines.

1,351,350. INTERPOSED FABRIC MACHINE: William S. Southwick, Clinton, Mass. App. filed April 22, 1918. Improved machine.

1,351,356. SOUND-DETECTING DEVICE; William S. Tucker, Thames Ditton, England. App. filed Jan. 6, 1919. For determining position of gun.

1,351,396. IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES; Albert H. Midgley, Acton Vale, Eng. App. filed Feb. 6, 1919. Reduces wiring.

1,351,422. ELECTRIC SIGNALING SYSTEM; Simon B. Hess, Jamaica, N. Y. App. filed Sept. 19, 1916. Fire alarm.

1,351,432. MUSIC RECORDER; Philip J. Meahl, Summit, N. J. App. filed March 27, 1919. Records on paper rolls.

1,351,443. CONTROL SWITCH FOR CINEMATOGRAPHIC TARGETS; William P. Robertson, New York, N. Y. App. filed June 7, 1919. Improved housing.

1,351,445. MEANS FOR HOLDING FORMED METAL PIECES WHILE THEY ARE BEING ELECTRICALLY WELDED; Herbert M. Smith, Great Barrington, Mass. App. filed Sept. 30, 1918. Holds parts exactly to size.

1,351,446. COMBINATION WELDING-MACHINE; Herbert M. Smith, Great Barrington, Mass. App. filed Sept. 30, 1918. Work held on a rotating arbor.

1,351,458. TREATMENT OF PETROLEUM AND LIKE OILS; Edward W. Wynne, Liverpool, Eng. App. filed Aug. 28, 1918. Improved apparatus.

1,351,478. ELECTRIC GLUE HEATER; Harry Kain, Con L. Miles and Glen A. Wilkinson, Wabash, Ind. App. filed Jan. 8, 1920. Simple structure.